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Development of a Supplemental Inspection Document for the Fairchild SA226 and SA227 Aircraft, Part 2, Volume I

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Technical Report

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16. Abstract

This report (consisting of volume I and volume II) is the second phase of a three-phase program sponsored by the Federal Aviation Administration to develop a supplemental inspection document for the Fairchild SA226 and SA227 aircraft. In this report, the results of material characterization and testing are presented. Crack growth analysis of all the critical structural elements using NASGRO is performed and the results documented.

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1. INTRODUCTION

This report presents the results of Phase II in the development of a Supplemental Inspection Document (SID) for SA226 and SA227 aircraft. Phase I consisted of establishment of the usage and stress spectra, identification of principal structural elements (PSE's), and review of service histories for these elements. Phase II tasks have included, for each PSE, collection of material properties, establishment of initial flaw size, inspection method, detectable flaw size, crack growth analysis, inspection intervals, and determination of widespread fatigue damage. Phase III will cover final development and publication of the SID and a final project report.

Using the data gathered in Phase I of this study, the principal structural elements of the SA226 and SA227 aircraft have been examined in detail. The principal analysis tool used was the crack growth program, NASGRO (version 2.0) [2]. All of the analysis neglected retardation effects. Each principal structural element was first examined to determine its critical location. The stress spectrum at the critical location was then calculated or determined from measurements, and an appropriate NASGRO crack case was selected. Where the crack growth life was determined to be short and inspection difficult, material testing was performed under a realistic load spectrum to experimentally verify the crack growth analysis method. In other cases, in-service experience or full-scale fatigue test results provided verification.

The original economic life of the airframe was set at 35,000 hours based on previous fatigue testing. A complete airframe was tested for 105,000 hours and then saw cuts were made and limit loads were applied [5]. Many of the PSE's were shown to be fail-safe by this test. A complete fail-safe analysis of the airframe was also performed, per FARs 23.571 and 23.572 [11, 19]. Using these results and operational experience as an empirical basis, the goal of the present study is to extend the economic life to 50,000 hours. As most of the aircraft have been converted to cargo service with lower utilization rates than new aircraft, an additional useful life of over 10 years is not unreasonable to expect.

It is clear from the present study that modifications will have to be made to the aircraft to improve inspectability and lengthen fatigue lives of critical structural elements. Phase III will address these issues.

2. ANALYSIS METHOD

2.1 NASGRO STRESS RELATIONSHIPS

In general, each NASGRO crack case requires a stress factor and an associated constant for each type of stress—tension, bending, bearing, and lateral. In this study, the stress factor usually equals the stress per g. The constant then equals the 1-g stress divided by the stress per g. The user-provided load spectrum gives the change in g load for each frequency of load exceedance. With these inputs, the stress for a given frequency of load exceedance is

$$\begin{aligned} S &= \text{Stress Factor} * (\text{Constant} \pm \text{Spectrum Value}) \\ &= \sigma/g * (\sigma_{1\text{-}g} / \sigma/g \pm \Delta g) \end{aligned}$$

This relation applies for each type of stress applicable to the crack case.

The relation is slightly different for landing cases where stress is available as a function of sink rate. Here, the stress factor equals the stress just before landing while the constant equals zero. The load spectrum provides normalized landing stress for each given frequency of sink rate exceedance. Therefore, the landing stress for a given frequency of sink rate exceedance is

$$\begin{aligned} S &= \text{Stress Factor} * (\text{Constant} \pm \text{Spectrum Value}) \\ &= \text{Stress before impact} * (0 \pm \text{Stress at sink rate/Stress before impact}) \end{aligned}$$

There are two failure criteria in NASGRO. Calculation stops when there is unstable crack growth or when the flow stress of the material is exceeded. The flow stress is defined as the average of the yield and ultimate stress for the material.

2.2 USAGE AND LOAD SPECTRA

The crack growth analyses in this report are presented in terms of schedules, a term used in NASGRO to represent the repeating portion of a load spectrum. In this report one schedule represents 5.5 hours of flight—one 0.5-hour flight, one 2.0-hour flight, and three 1.0-hour flights. These comprise the usage spectrum developed in Phase I.

The maneuver and gust load spectrums for each of the three flight lengths were determined for the SA226 and SA227 models in reference 1. These spectra are reproduced in Figure 2-1 on a per 35,000-hour basis. Note that the SA226 spectrum, although the most severe, is the same for all three flights. This spectrum was used for each PSE applicable to the SA226 or to both the SA226 and SA227. The SA227 spectra were used only for those PSE's applicable to the SA227 only. In all cases the exceedances of a given positive acceleration level were also assumed to occur for the corresponding negative acceleration level. This is conservative since there are generally fewer exceedances of the negative acceleration levels.

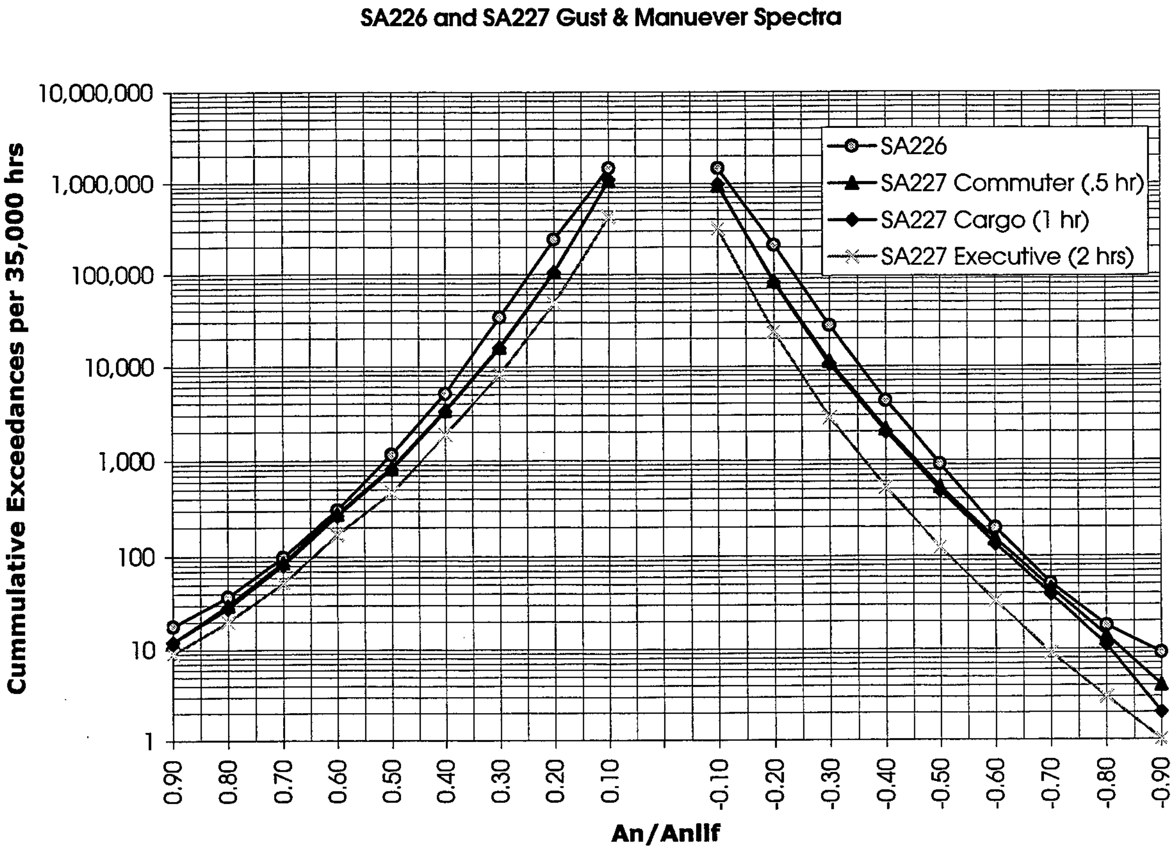


FIGURE 2-1 SPECTRUM COMPARISON - SA226 AND SA227

For taxi and landing conditions, the exceedance spectra were assumed to be the same for both aircraft models. These spectra, which were presented in reference 1, are not reproduced here. Two additional spectra were developed for this report. For cases where landing stress was not available as a function of sink rate, a spectrum of peak acceleration at landing was developed using data obtained from reference 4. Ground reaction loads were measured for various sink rates at a gross aircraft weight of 15,675 lbs. These measurements led to the graph shown in Figure 2-2. Plotted on the graph are peak acceleration vs. sink rate and the best-fit parabola. The best-fit parabola and the landing spectrum from Phase I are used to construct the spectrum given in Table 2-1 for use in selected PSE analyses.

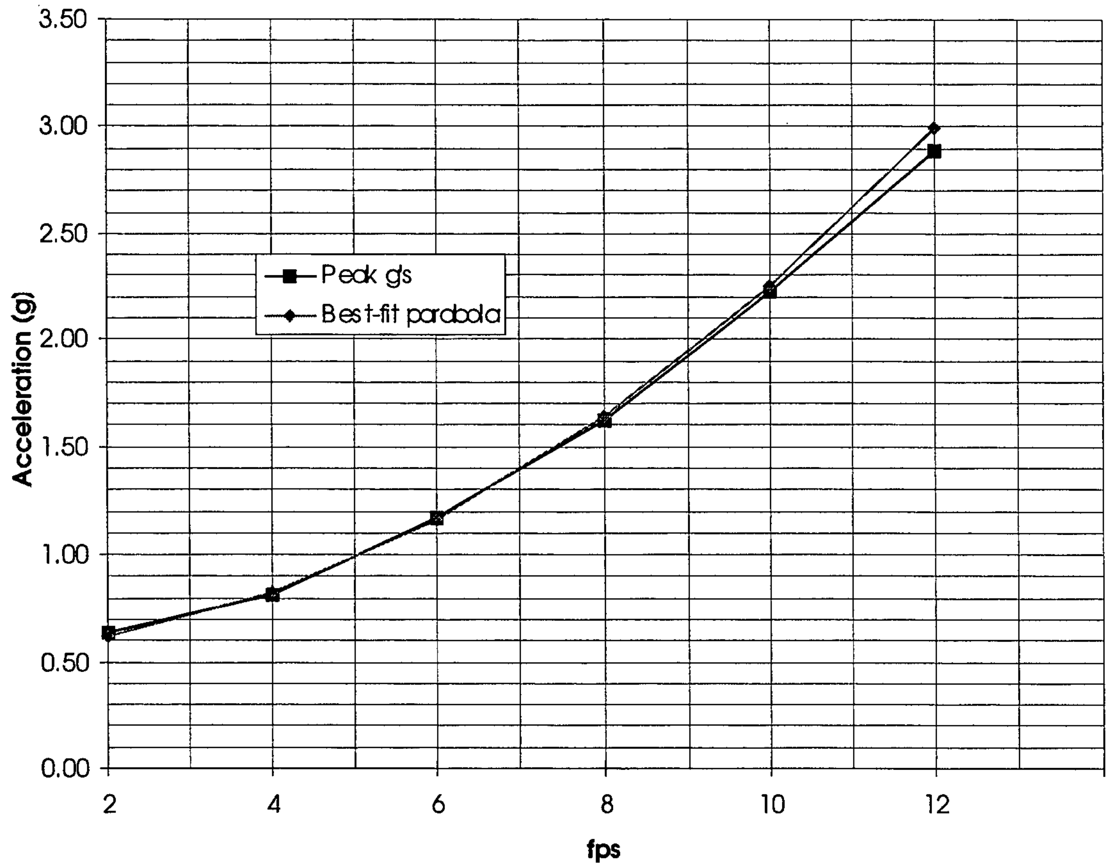


FIGURE 2-2 PEAK ACCELERATION VS SINK RATE (15,675 LBS)

A spectrum for prop wash effects on the empennage was also developed and is explained in the section on the horizontal and vertical stabilizer group.

All of the load spectra used for NASGRO crack growth analysis are given in Appendix D in volume II of this report.

TABLE 2-1 PEAK ACCELERATION VS. SINK RATE

Exceedances per 10,000 flights	Sink Rate (fps)	Peak Acceleration (g's)
2,750	~0	0.55
4,400	1	0.57
2,200	2	0.62
590	3	0.70
48	4	0.82
12	5	0.98

2.3 DETERMINATION OF FASTENER LOADS

Generally, the distribution of loads in fastened joints was determined by the method outlined in reference 7. Fastened members are treated as axially loaded bar elements joined by fastener elements whose shear stiffness is a function of fastener diameter and material as well as thickness and material of the joined members. A finite element stiffness matrix of the joint is then constructed and solved in Excel. This approach allows rapid what-if analyses for variations in the PSE geometry. In cases where the axial bar approximation appeared unsatisfactory, the joint was modeled in NASTRAN with plate elements to represent fastened members and DOF spring elements to represent fasteners. Stiffness values of the DOF spring elements are determined as above.

During fatigue tests and field strain surveys, stresses were measured for a variety of load and center of gravity (c.g.) conditions. In all cases the analysis was performed using the highest stress measurement at a given location.

2.4 ADDITIONAL NASGRO CRACK CASES

The standard NASGRO crack cases do not account for the additional undamaged area that may be available in a structure to assume load as the cracked member weakens. For example, as a crack propagates in a spar cap, the cap looses stiffness and load is transferred to other elements of the cap assembly. Failure to account for this effect can substantially reduce the life predicted by the analysis. Therefore new crack cases, TC11 and TC12, were developed based on TC03 and TC02. TC11 and TC12 prompt for input of the amount of additional area as well as principal moments of inertia and the centroid of this area. Then as the crack progresses, the remote and local stresses in the cracked member are reduced according to the magnitude of these input values relative to those of the cracked member. The formula for the reduced remote stress is as follows.

$$S_{red} = S * [(W - c) / W] * \{(W*t + Area_3) / [(W - c)*t + Area_3]\}$$

Here W and t are the width and thickness of the cracked member, c is the crack length, and $Area_3$ is the area of the additional undamaged material. The beneficial effect of this correction is small until the crack becomes relatively large. For example, the graph in Figure 2-3 shows how the reduction factor varies with crack length and $Area_3$ when W = 3.0 inches and t = 0.125 inch.

The FORTRAN source code for modified crack cases is given in Appendix E of volume II. This code has been checked by Southwest Research for errors. When performing the analysis it was noticed that the crack growth curves obtained with the modified code have the same basic shape but extend the predicted life by 20%-50% over the standard models. These are not unreasonable results, since it is well known that a small variation in stress level or material condition can have a large effect on

crack growth rate. The modified cases were used to analyze only four areas, each in the multielement wing spar caps at stations 9, 27, and 99.

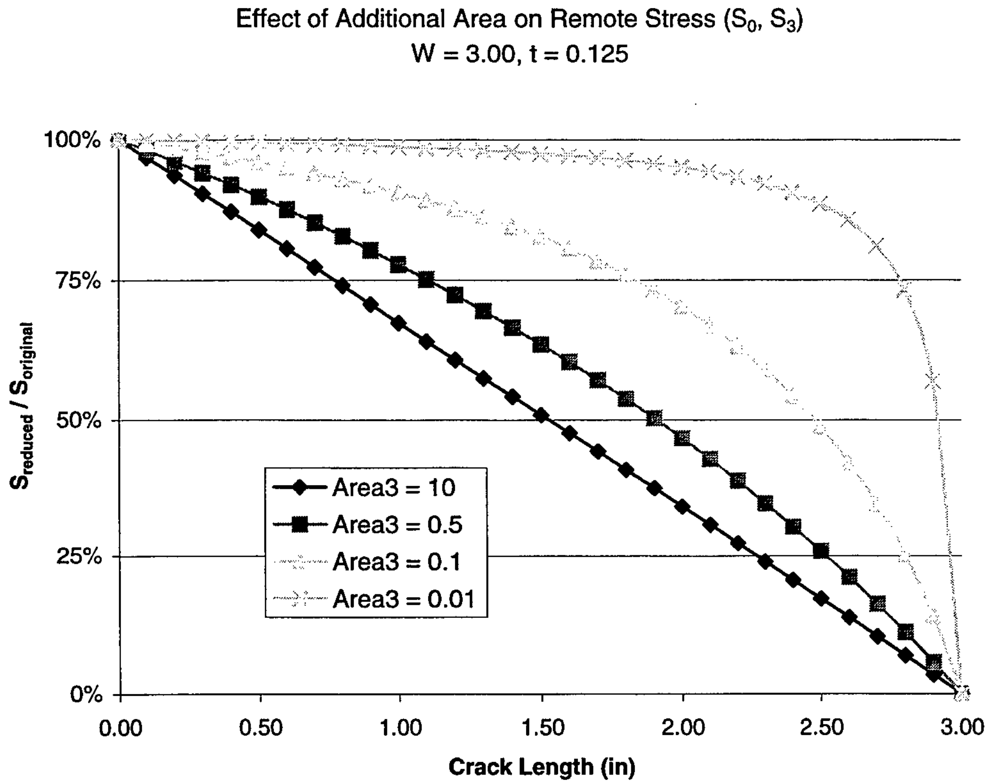


FIGURE 2-3 STRESS REDUCTION IN MODIFIED CRACK CASE

2.5 INITIAL FLAW ASSUMPTIONS

No comprehensive study of initial manufacturing flaws is available for the SA226 and SA227 aircraft. Therefore, the crack growth analyses in this report were performed using the initial flaw assumptions shown on page 4-79 of reference 3. These assumptions, which were based on two separate studies of retired U.S. Air Force airframes, are as follows.

Initial Rogue Flaws:

- Represent gross manufacturing defects and material nonconformities
- Actually present in very few structures
- Applicable to the critical location of each PSE
- Assumed Size:
  0.05- x 0.05-inch corner flaw (material thicker than 0.05 inch)
  0.05-inch through thickness crack (material 0.05 inch thick or less)

Average Quality Flaws:

- Represent typical manufacturing flaws (nicks, scratches, etc.)
- Present in virtually all structure
- Applicable for continuing damage after termination of primary growth
- Assumed Size:
  0.005- x 0.005-inch corner flaw (material thicker than 0.005 inch)
  0.005-inch through thickness crack (material 0.005 inch thick or less)

Although quality control should eliminate most rogue flaws, a conservative damage tolerance analysis must assume at least one at the most critical location in each PSE. Average quality flaws are by definition numerous in a structure and are assumed to exist where continuing damage is considered after termination of the primary crack. Since material thickness of 0.005 inch is rarely encountered, the average quality flaw is typically a 0.005- x 0.005-inch corner crack. However, in crack growth programs such as NASGRO a 0.005-inch through crack is often simpler to model and gives more conservative results.

2.6 MATERIAL PROPERTIES

The NASGRO 2.0 database [14] contained crack growth properties for most of the PSE materials. There were several exceptions, however.

- The wing spars and stub stringers (PSE's W1, W2, W3, W4, and W7) are built with 2014-T6511 extrusion. For this material, parameters used in the NASGRO da/dN equation were determined by test, as explained in the section on PSE W1 and detailed in Appendices F and G of volume II.

- The engine mount (PSE EM1) is fabricated from 4130N tubing. As this material is not included in the NASGRO database, justification for the use of 160-180 UTS 4340 plate constants in the analysis is provided in the section on PSE EM1.

- Several PSE's in the nacelle and empennage contain 2024-T42. Again, this material is not in the NASGRO database. However, Figure 2-4 shows that for crack growth analysis, the available NASGRO materials can be conservatively used in lieu of 2024-T42. The 2024-T42 crack growth rate equation was determined from tests detailed in reference 18. The lower growth rate can be explained by the relatively thin section that was tested as well as the softer clad finish. These curves are actually close to being within the range of scatter for typical crack growth rate tests.

A complete record of all material properties used for the analysis of each PSE can be found in the output files given in Appendix C.

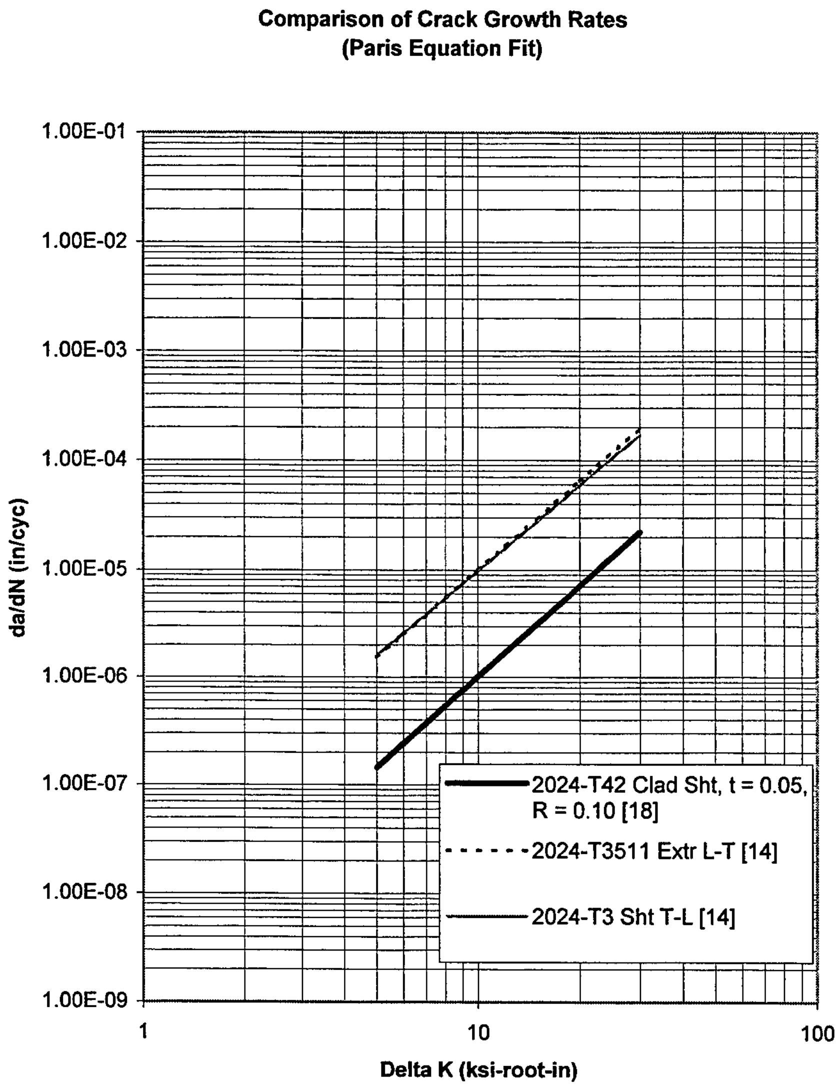


FIGURE 2-4 COMPARISON OF CRACK GROWTH RATES FOR SEVERAL NASGRO MATERIALS AND 2024-T42

2.7 DETECTABLE CRACK SIZES AND INSPECTION INTERVALS

The detectable crack sizes for the standard inspection method are taken from earlier damage tolerance work of other manufacturers. Table 2-2, based on data in reference 20, represents the conservative end of the spectrum for 90% probability of detection curves.

TABLE 2-2 DETECTABLE CRACK SIZES

NDI Method	Detectable Flaw Size (in)
Surface Eddy Current	0.10-0.16
Visual	0.25
Magnetic Particle	0.10
Florescent Penetrant	0.10
Bolt Hole Eddy Current	0.08

Although X-ray inspection is currently recommended in the Airframe Airworthiness Limitations Manual for inspections of the main spar lower cap, X-ray will be ruled out as an inspection method for the SID. This decision is made because of the high dependence on inspector skill and low repeatability.

Once the crack growth curve has been determined and an inspection method chosen, the inspection intervals are set using the following general rules. The initial inspection threshold is typically set as one-half of the crack growth life of the component or assembly. The repeat inspection interval is then set as one-half of the time from the detectable crack size to the critical crack size. These relationships are shown graphically in Figure 2-5.

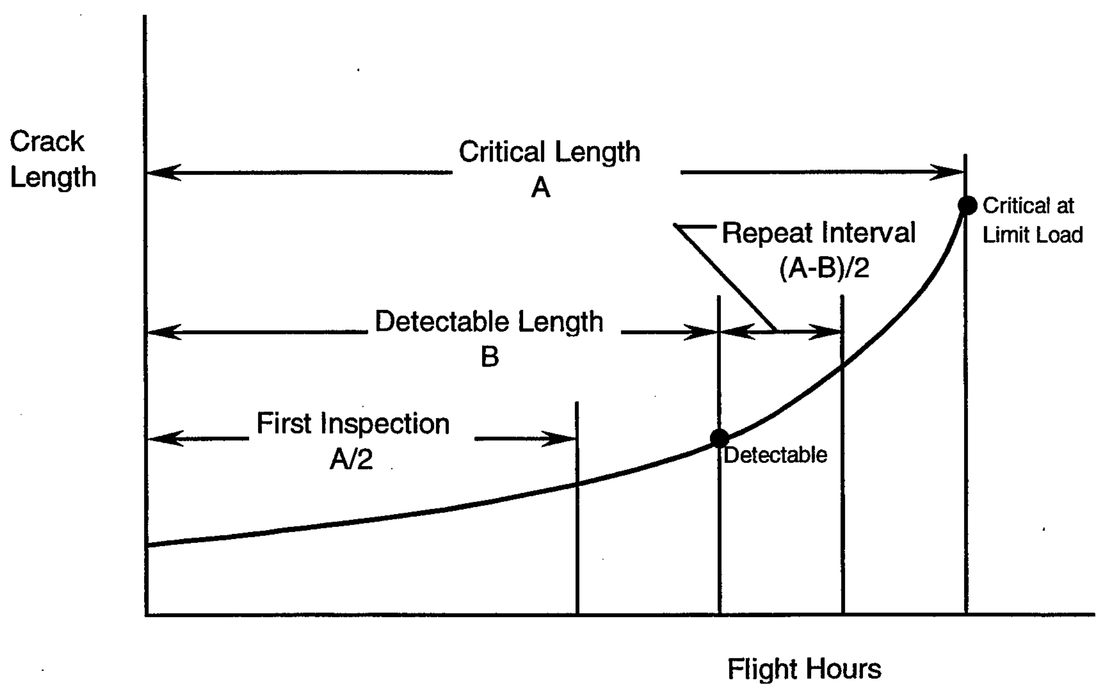


FIGURE 2-5 DETERMINATION OF INSPECTION INTERVALS

3. SA226 FULL-SCALE FATIGUE TEST

A full-scale fatigue test of an SA226 airframe was performed in 1978-1980 to uncover unexpected problem areas in fatigue, establish a basis for inspection intervals, and confirm the fail-safe character of the design. The spectrum imposed on the airframe was identical to the SA226 spectrum shown in Figure 2-1.

The following overview of the test is reproduced from reference 12. The discussions of inspection intervals therein should not be construed to supersede the present study, which relies on crack growth analysis and assumptions of rogue flaws at critical areas of the airframe.

> A full-scale fatigue test was planned for the SA226 series aircraft in 1977 as an exploratory effort to gain confidence in the fatigue behavior, e.g., time to first crack initiation, crack locations, and propagation rates, which determine the inspection intervals. With such a test, as the airframe accumulated large amount of operational hours, Fairchild Swearingen could be much more confident that inspection locations, time to initial inspections, and time between inspections as defined in the then existing documents were conservative. A life limit was not the goal. The SA226 series had been shown fail-safe by analysis.
>
> The fatigue test was a very rationally developed procedure which balanced the airframe as it would have been in flight. Among other things, the tail was fatigue tested in a rational manner. Although the horizontal and vertical tail components were not required to meet FAR 23.572 at the time of certification, the spars and forged fittings are composed of multiple load paths including the horizontal stabilizer pivot bolt which is a bolt within a bolt. The actuator is a dual unit.
>
> It is worth mentioning that cracks in the few expected areas had not occurred after 80% of the third lifetime (i.e., after 98,000 hours). At this point, simulated cracks were placed in the structure by sawing cuts adjacent to rivet holes. None of these cracks grew a noticeable amount during the remaining testing. A simulated crack was added in the rear spar which was not in the original plan for the fatigue test. After testing was completed, the intentional cracks were extended further and limit load was applied, then 91.7% of ultimate load, with no apparent crack growth.
>
> Many of the cracks that did occur were repaired at discovery while others were allowed to grow being in secondary or redundant structure. After the fatigue test, these failed areas were subjected to limit load, then 91.7% of ultimate load without incident. None of the sawed cracks grew.

The locations of the saw cuts were described as follows in reference 13. Although this document was written before completion of the fatigue test, the proposals it contains were actually carried out, as indicated in the final report of the fatigue test results [5].

> To substantiate the fail-safe characteristics and establish appropriate inspection intervals on the SA226 aircraft, it is proposed to modify the structure of the fatigue test aircraft when the test reaches 80% of the third lifetime of the fatigue spectrum. The proposed modifications are listed below.

Wing Station 99.5 [PSE W1]

By analysis (reference Swearingen report 2601-R368, page 15) the main spar at wing station 99.5 appears to be the highest-stressed location in the aircraft during normal operation. The last fastener in the titanium strap on the rear side of the main spar on one wing and on the forward side on the opposite wing will be removed and a 0.05″ saw slit made through the depth of the hole, perpendicular to the spar. The fastener will be re-installed and the region x-rayed. The growth of this "crack" will be checked at every 2 1/2% of life or as necessary.

Wing Station 9.28 [PSE W2]

This location is the second highest stress location in the wing. The load spectrum is different here than at wing station 99 due to the much stronger influence of the ground-air-ground cycle loads. A fastener will be removed from the bottom aft side of the main spar on one wing and on the bottom forward side on the other wing. A 0.05″ deep slit made through the thickness of the spar similar to the saw slit at WS 99. The fasteners will be reinstalled and growth of the "crack" monitored.

Fuselage "T" Stringer [PSE F1]

The top centerline "T" stringer at approximately fuselage station 360 experiences a transverse stress due to fuselage pressure and an axial load due to fuselage bending loads. At 80% of the third life, a ¼″ longitudinal through crack will be introduced at one of the rivet holes and the rivet reinstalled. This crack will be monitored for the rest of the test.

Fuselage Forward Pressure Bulkhead [PSE F11]

The forward pressure bulkhead at fuselage station 69.31 resists the internal pressure by bending of hat section stringers on the aft face and channel section stringers on the forward face. The location with the highest tensile stress appears to be the 27-21063-3 and –4 channels at WL 94.5 and BL 18.5 right and 18.5 left. A saw cut will be introduced at these two locations through about ½ breadth of the outstanding flange on one side and about ¼″ long through a wiring harness hole in the web on the opposite side.

Vertical Tail [PSE V1]

A cut will be made in the main spar of the vertical tail at about water line 130. The cut will be made from a rivet hole in a direction away from the web. The cut will be long enough to extend beyond the rivet head when the reinstalled. This spar picks up load from the horizontal tail. This "crack" will be monitored for the rest of the test.

Horizontal Tail [PSE H1]

A cut will be made in the top of the rear spar of the horizontal tail at about BL 20, through the last fastener in the strap that ends at this location. The cut will be made in a direction away from the web and long enough to extend beyond the rivet when it is reinstalled. This crack will be monitored for the rest of the test.

Cargo Door Latch

The forward bottom cargo door click-clack will be removed and 15 cycles of 7.5 psi pressurization applied. The door and door frame will be visually checked for damage every few cycles.

Limit Load Test

At the end of the third life, the structure will be loaded to flight limit load by applying a loading condition of 2.0-g gust, multiplied by a factor of 2.167/2 to raise the loads to limit. This will be followed by a condition at 32 ft/s lateral gust multiplied by 1870/1120 to raise the maximum load to limit gust for the vertical tail. After the limit load is applied, the crack started at fuselage station 360 will be elongated to 5″ and the fuselage pressurized to 7 psi.

As indicated in reference 5, no growth was measured at any of the locations where an initial cut was made. However, this fact will not supersede any of the crack growth analyses presented in the remainder of this report. The impact of the fatigue test and other fail-safety analysis on the damage tolerance analysis of the airframe will be discussed as applicable in the sections on each PSE.

4. WING GROUP

4.1 PSE W1 SA226 MAIN SPAR LOWER SURFACE AT WS 99

The SA226 main spar consists of a spar cap and two angles all made from 0.125-inch-thick 2014-T6511 aluminum extrusions. Inboard of wing station 99.5 the spar is reinforced by four titanium straps, which continue inboard to the wing centerline. Additional reinforcement is present inboard of wing station (WS) 27. The abrupt change in wing spar stiffness at the ends of the titanium straps causes a stress increase at this location. The theoretical 1-g stress distribution for the SA226 main spar at 12,500-lbs maximum takeoff weight (MTOW) is shown in Figure 4-1. This distribution was constructed by adjusting the SA227 analytical distribution from reference 6, accounting for differences in moment and wing cross section. The sharp increase in stress at WS 99.5 makes it an obvious location for further study. The actual in-flight stress at this location has been measured and was reported in Table D-11 of reference 1.

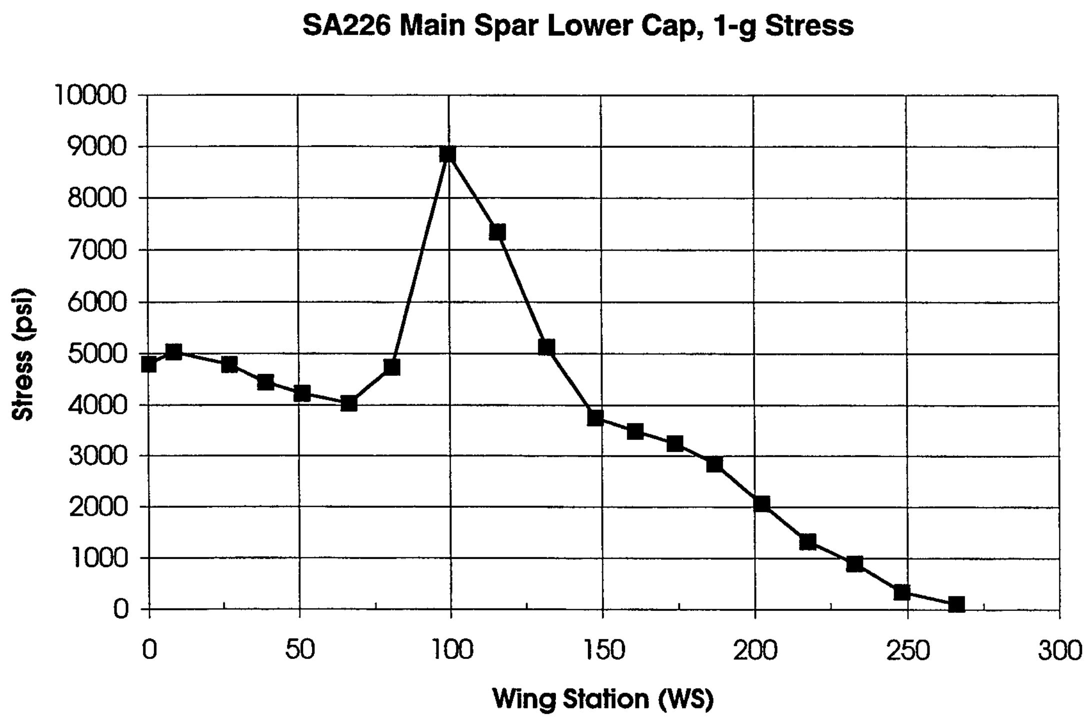


FIGURE 4-1 ONE-g STRESS DISTRIBUTION, SA226 MAIN SPAR (12,500 lbs MTOW) FROM FINITE ELEMENT ANALYSIS

To determine the growth rate for a crack at this location it is necessary first to determine the load transfer between the various layers of material that make up the spar cap. This was done with a finite element analysis in Excel. The results of the analysis for a unit load applied to the cap are shown in summary form in Figure 4-2. There it can be seen that the load transfer between layers is greatest between the aluminum and titanium layers at the first fastener inboard of the titanium strap ends. At this point the load

transfer is more than twice that at the second row and five times greater than at the third row. (Note: forces do not sum exactly to zero due to round-off error.)

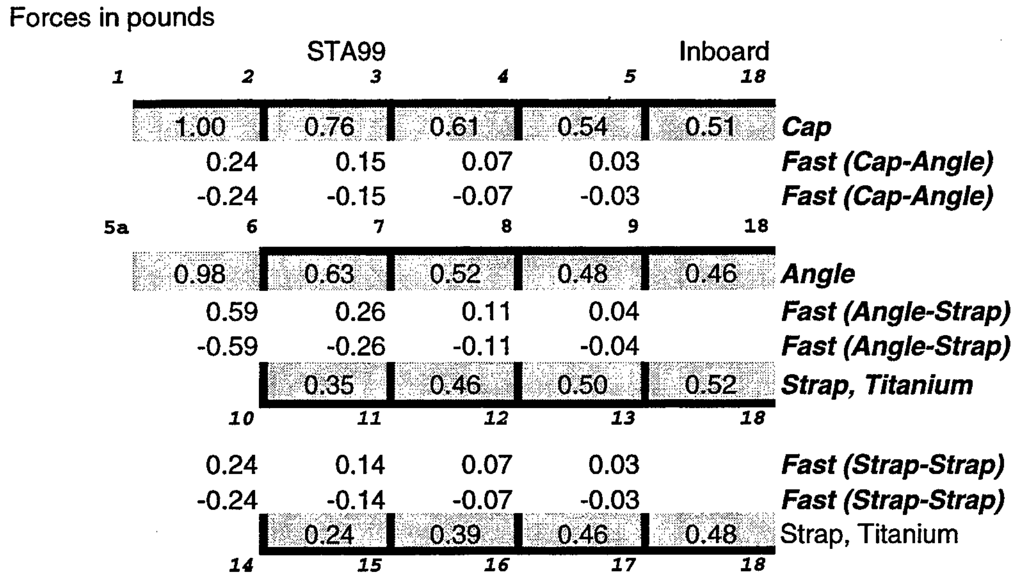


FIGURE 4-2 PSE W1 FINITE ELEMENT RESULTS, UNIT LOAD CASE

NASGRO crack case CC02 was used to predict the growth of a 0.05- x 0.05-inch corner crack propagating from a hole in the last fastener row to the edge of the part. This analysis was performed for both the cap and angle. CC02 reverts to case TC03 when the corner crack penetrates the thickness; for a more accurate prediction, the modified case, TC11, was also run from this point onward. Then, once the short ligament had completely failed, a 0.005-in through crack was assumed to exist at the opposite side of the hole. The growth of this crack was analyzed using TC02 and the modified case, TC12.

The chart in Figure 4-3 shows that the angle is the critical member due to its larger bearing stress. The life predicted for the angle by the modified analysis is about 9,000 schedules. This is equivalent to 49,500 flight hours. At this point the critical crack length is 0.80 inch. Note that less life is added by the modified analysis for the cap because the cap has a larger portion of the total area in the assembly than the angle has.

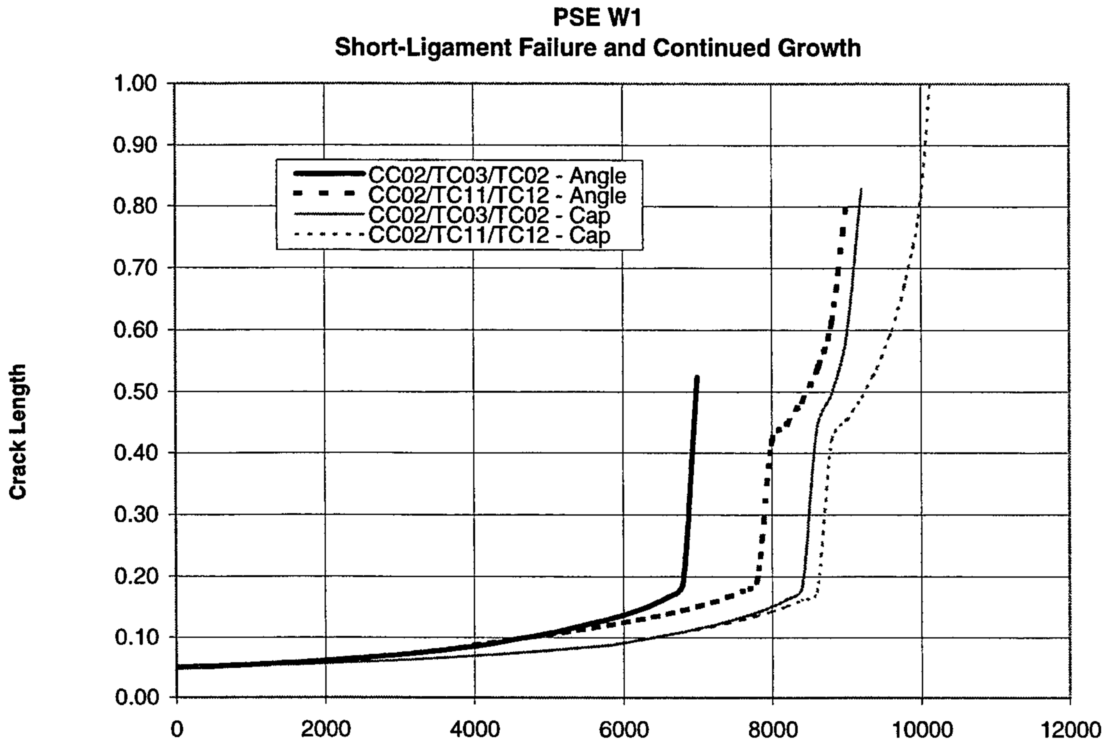


FIGURE 4-3 PSE W1 SA226 MAIN SPAR LOWER CAP WS 99

The spar assembly has been shown fail-safe by analysis and tests [refs R190, R715]. For cost reasons it is desired to eddy-current inspect only the edges of the assembly, the vertical legs of the angles, and the exposed protrusion of the cap. (A bolt hole eddy-current inspection would be significantly more expensive and risky to the structure, due to the difficulty in removing the permanent steel fasteners.) However, to justify these inspections it must be shown that they would detect a crack in the angle before the assembly loses limit load capability. The desired inspection locations are shown in Figure 4-4. Note that the surfaces inside the wing are coated with sealant, which must be removed prior to inspection.

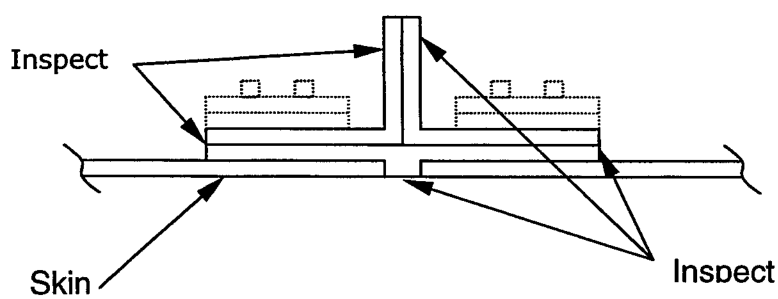


FIGURE 4-4 INSPECTION LOCATIONS FOR MAIN SPAR LOWER CAP

Two crack scenarios have been checked to verify that the inspections can detect failure of the first cracked member before a crack in a second member reaches critical size. Both scenarios involve rogue flaws at an outer fastener hole in one of the angles and an average crack in the corresponding fastener hole in the cap. In the first scenario the

Both scenarios involve rogue flaws at an outer fastener hole in one of the angles and an average crack in the corresponding fastener hole in the cap. In the first scenario the cracks are in the short ligament, growing toward the part edge where they can be detected. In the second scenario they are in the long ligament, growing away from the edge and thus cannot be detected until they reach the center of the spar assembly. Figure 4-5 shows the two crack scenarios.

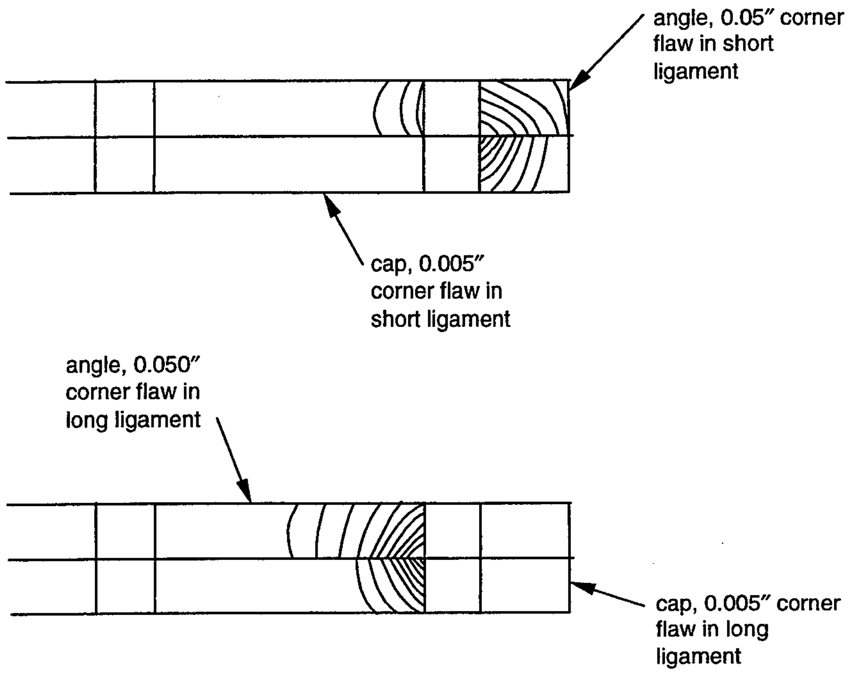


FIGURE 4-5 TWO CRACK SCENARIOS FOR SPAR CAP

Scenario one has been plotted in Figure 4-6. Note that the curve for the rogue flaw in the angle has been taken directly from Figure 4-3. To obtain the curve for the average flaw in the cap, several assumptions have been made. First, when the angle fails at about 9,000 schedules, 50% of its load is transferred to the cap. The other 50% transfers to the opposite angle. Second, the cap now picks up the load from the last row of fasteners in the titanium straps. This sharply increases the bearing stress in the cap. The revised finite element analysis and NASGRO input are given in Appendices A and B, respectively.

Figure 4-6 demonstrates that an inspection program could be devised to detect failure of the angle before failure of the cap. Since the angle life is about 9,000 schedules, the threshold could be set at 4,500 schedules (24,750 hours). A repeat inspection interval of 500 schedules (2,750 hours) would be sufficient to catch impending failure of the angle before the cap had time to fail. The reverse situation—a rogue flaw in the cap and an average flaw in the angle—yields a more generous threshold but the same repeat interval. This is because the cap initially has a lower bearing stress, but after failure of one of the members, the stresses are essentially the same regardless of which member has failed.

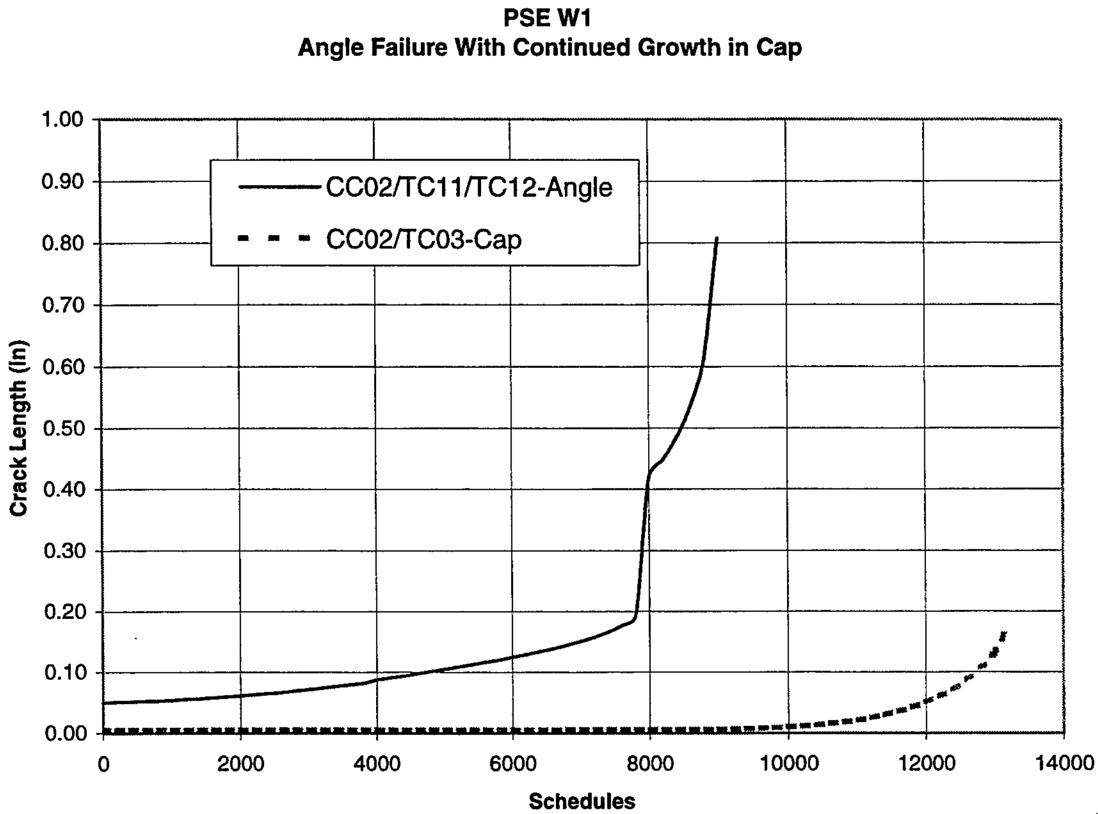


FIGURE 4-6 CRACKS GROWING TOWARD EDGE OF SPAR ASSEMBLY

The second scenario – cracks in the long ligament growing away from the part edge – is a less severe damage case from a crack growth standpoint. This is demonstrated by Figure 4-7. Several conservative assumptions were made to obtain these curves. NASGRO does not have a model for a corner flaw growing between adjacent holes. Therefore, the model CC02 was used for the initial growth of the corner crack. This is conservative because CC02 assumes the crack is on the more intensely stressed short ligament. Once the corner crack penetrated the thickness, the model TC05 was used to analyze growth to the adjacent fastener hole. These curves also assume that when the crack in the angle reaches the adjacent hole at approximately 14,000 schedules, the angle fails and dumps half its load to the cap. At that time the bearing stress in the cap also increases dramatically.

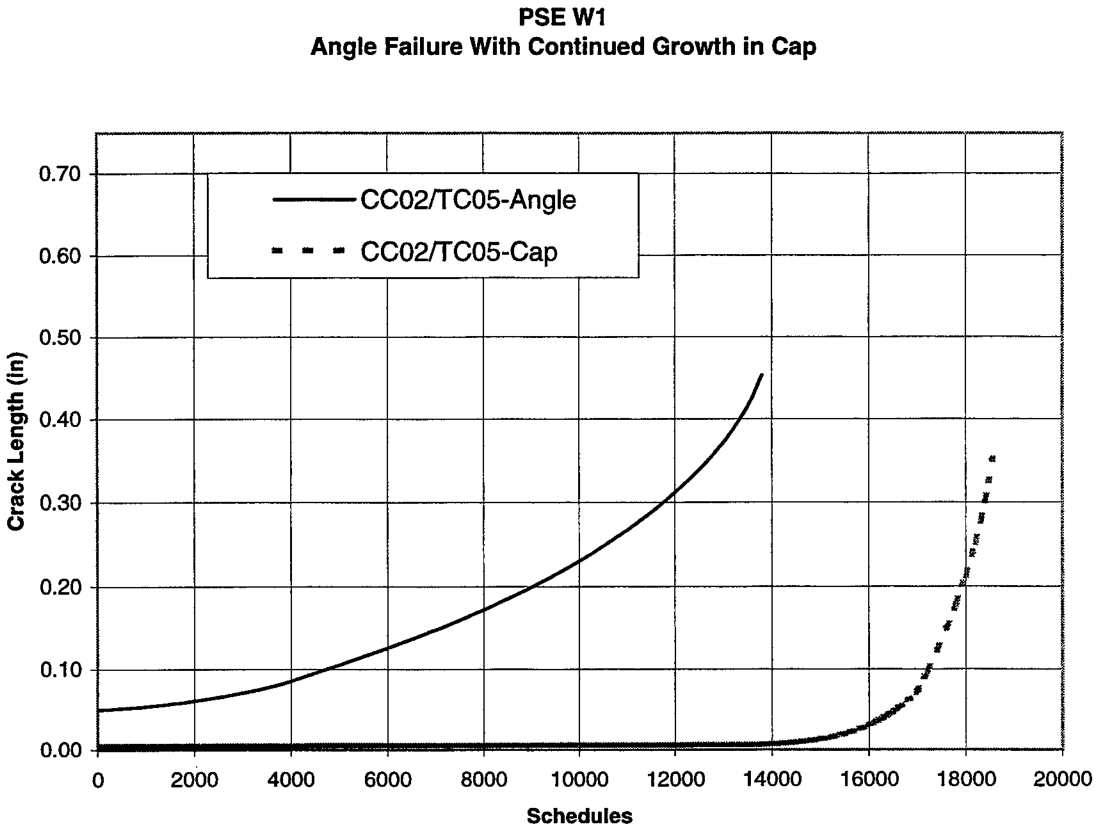


FIGURE 4-7 CRACKS GROWING TOWARD CENTER OF SPAR

Now that an idea of the required inspection intervals has been gained, the next step is to determine the spatial extent of the inspections. This is done by observing how the crack growth life increases with distance away from WS 99 (the critical area). At a sufficiently far distance the life is too long to warrant inspection. As shown in Figure 4-1, the stress drops about 15% at WS 112 and 30% at WS 125. In addition the fastener holes in this area are essentially unloaded. These characteristics lead to the results in Figure 4-8. These curves show failure of the short ligament only. Therefore, it is evident that for the 50,000-hour goal the inspections should extend about one foot outboard of WS 99. On the inboard side only a few fastener rows need to be checked because the titanium straps drastically reduce the stress and provide additional fail-safe area.

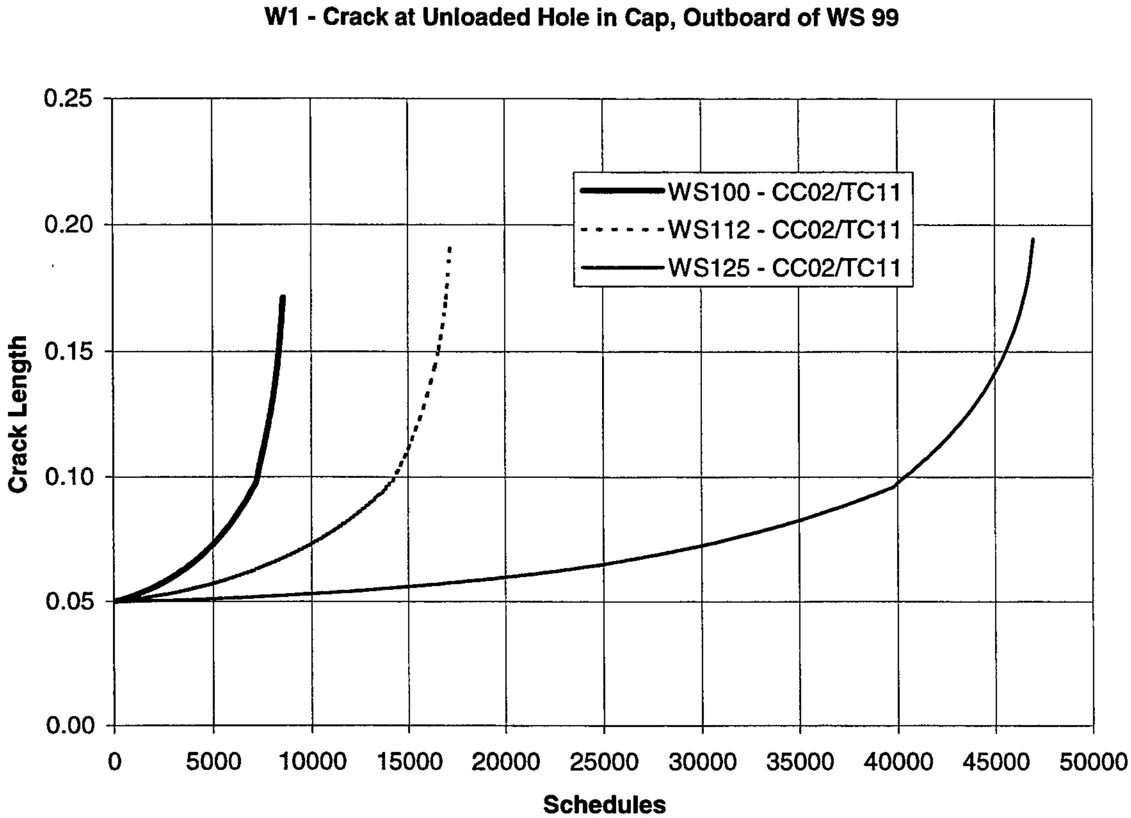


FIGURE 4-8 DETERMINATION OF EXTENT OF INSPECTION FOR W1

An initial 0.050-inch flaw through the thickness at the edge of the cap was also analyzed for comparison to damage at a fastener hole. An analysis based on crack case TC02 shows that, for the loading spectrum of these aircraft, an initial edge flaw grows many times slower than an initial flaw at a hole. This result is illustrated by Figure 4-9.

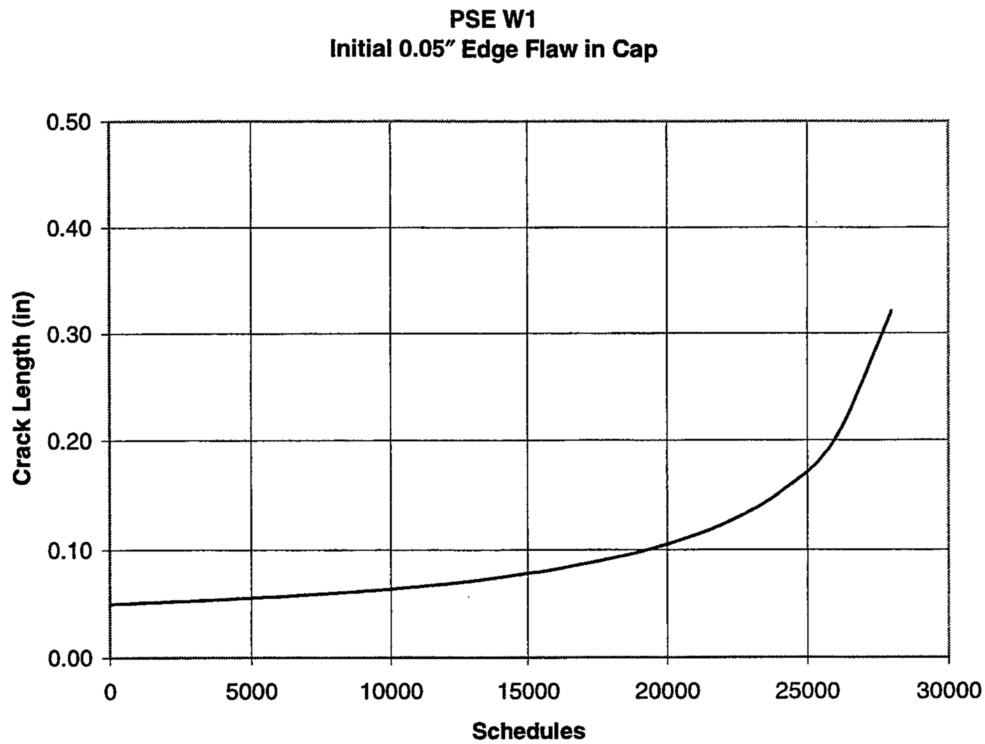


FIGURE 4-9 PSE W1 GROWTH OF INITIAL EDGE FLAW IN CAP

To support the analytical predictions in this report, Southwest Research Institute (SWRI) was contracted to build and test representative samples of PSE W1. Their final report is included as Appendices F and G of volume II. A first step in the SWRI study was to experimentally determine crack growth material constants for 2014-T6511 extrusion in the T-L orientation. The constants were found using standard test specimens built from spar cap material supplied by Fairchild. These constants have been inserted into the NASGRO material database and used for crack growth analysis where appropriate.

For a given loading spectrum, geometry, and material, the SWRI experimental results are in good agreement with NASGRO analysis. However, the SWRI tests cannot be used to set the actual life of the PSE since they were performed with somewhat different stress levels and geometry than exist in the real aircraft. Refer to Appendices F and G of volume II for a full discussion of the procedures, results, and limitations of the material tests relating to PSE W1.

4.2 PSE W2 SA226 MAIN SPAR LOWER CAP AT WS 9.0

At this location the upper cap of the main spar is lowered to clear the cabin floor, reducing the overall spar depth. The result is increased bending stresses in the spar caps and potential cracks which are difficult to detect initially.

All of the stiffening straps and angles at this location continue outboard at least several fasteners past WS 9.0, and these members are thin in comparison to the total spar

depth. Therefore bearing loads in the fasteners have been neglected. Stress on the main spar lower cap was recorded at WS 13.4 by gage 2029 (Table D-10 of reference 1) during flight and at WS 31.5 by gage 21 during landing. The 1-g stress at WS 13.4 was about 4.4 ksi and the stress per g was 6.6 ksi. To obtain the stress at WS 9.0, the measured stress is multiplied by the ratio of c/I at WS 9.0 to c/I at WS 13.4. The lesser spar depth at WS 9.0 results in 14% higher maximum stress than at WS 13.4. Appendix A contains details of this calculation.

The growth of a 0.05- x 0.05-inch corner crack in the spar cap, emanating from one of the fastener holes toward the part edge, was analyzed using NASGRO crack cases CC02 and TC11. These models predict that the crack becomes unstable after about 5200 schedules (28,600 hours), at a length of 0.42 inch as shown in Figure 4-10. The shorter life at this location versus WS 99 is due to the larger stress per g and larger diameter fasteners used to secure the assembly. (PSE W2 is also subjected to damaging taxi bumps but these have a small effect on crack growth.) The continued growth of an initial 0.005-inch through crack on the opposite side of the hole was also analyzed, but this crack becomes unstable almost immediately after the primary crack reaches the part edge.

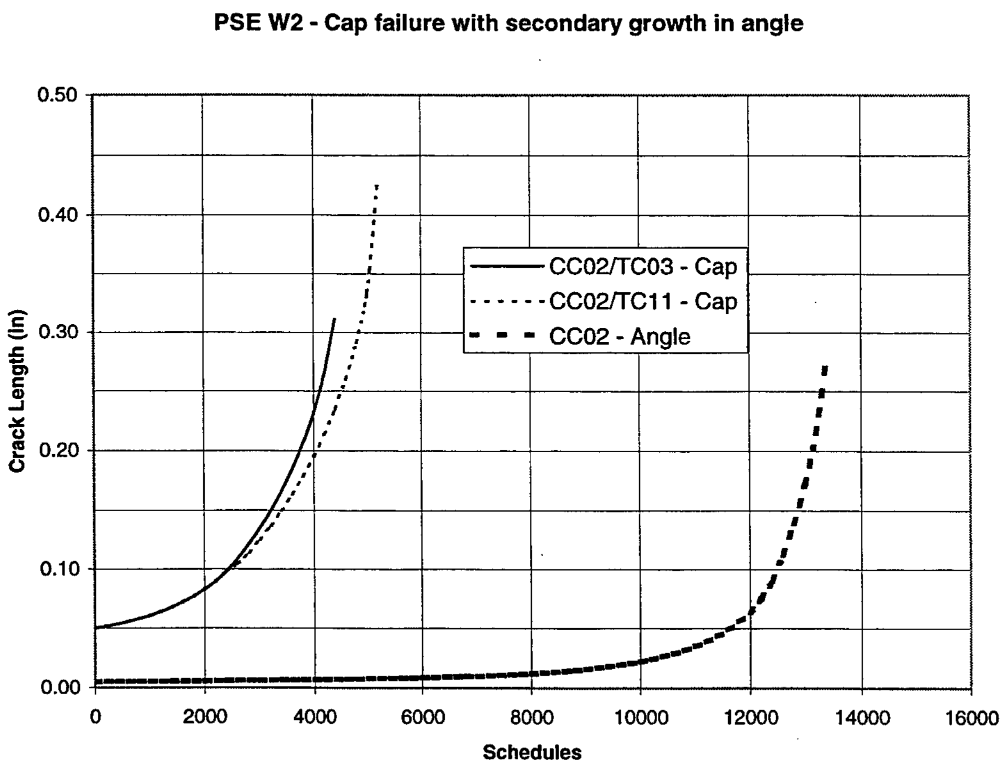


FIGURE 4-10 PSE W2 SA226 MAIN SPAR LOWER CAP WS 9.0

The same approach to inspection can be taken for WS 9 as for WS 99; that is, to only inspect the edges of the cap elements for total crack-through. Referring to Figure 4-10, the threshold inspection should be set at 2600 schedules (14,300 hours). However, the

repeat inspection can be longer than that for WS 99 because of the additional area in the assembly. Each of the aluminum members accounts for only about 15% of the total area. Therefore, the stress in the remaining members increases modestly upon failure of one member. Figure 4-10 also shows the growth of a 0.005″ flaw prior to and after failure of the cap. When the cap fails, the stress in the angle is increased by about 18%.

Later SA226's as well as all SA227's have removable bolts in this area that allow eddy-current inspection of the holes. Also, all aircraft except a few early SA226's have access plates in the outer webs to enable inspection of the center spar web and the top edges of the aluminum angles. For aircraft that do not have removable bolts, the SID will require installation of the access plate per service bulletins 226-57-006, 226-57-007, and 226-57-008.

Complete failure of a spar cap element would be evident by visual or eddy-current inspection of the part edge and the ridge that protrudes from the skin. Other elements at this location – the remaining aluminum sections as well as four titanium straps and two steel angles – would assume the load from the failed member. Fail-safety with the aluminum angle or cap missing was shown by analysis [11] and by test. In the fatigue test a 1.0-inch cut was made through the entire cap assembly (six layers including the skin) at one of the fastener holes. No failure occurred when limit load was applied [5].

4.3 PSE W3 SA226 REAR SPAR LOWER CAP AT WS 27.0

The rear spar of the SA226 aircraft consists of back to back angles reinforced where necessary with titanium and steel straps and steel angles. Inboard of WS 27 the spar web is supplemented by two pressure plates that support fuselage pressurization loads and provide redundant load paths for vertical shear. These pressure plates are attached to the rear spar angles by steel angles that increase the cross-sectional area available to carry bending loads.

Stress concentration naturally arises in the aluminum spar angles where the steel angles end. The worst location is in the aft angle at the last fastener. A stiffness model created in Excel, considering only the horizontal leg of each angle, determined the load in the last fastener to be about 41% of the applied load (Appendix A). A NASTRAN finite element model was also created using plate elements, including both legs of each angle. The NASTRAN model is depicted in Figure 4-11. This model calculated a fastener load of about 19% of the applied load in the aluminum angle.

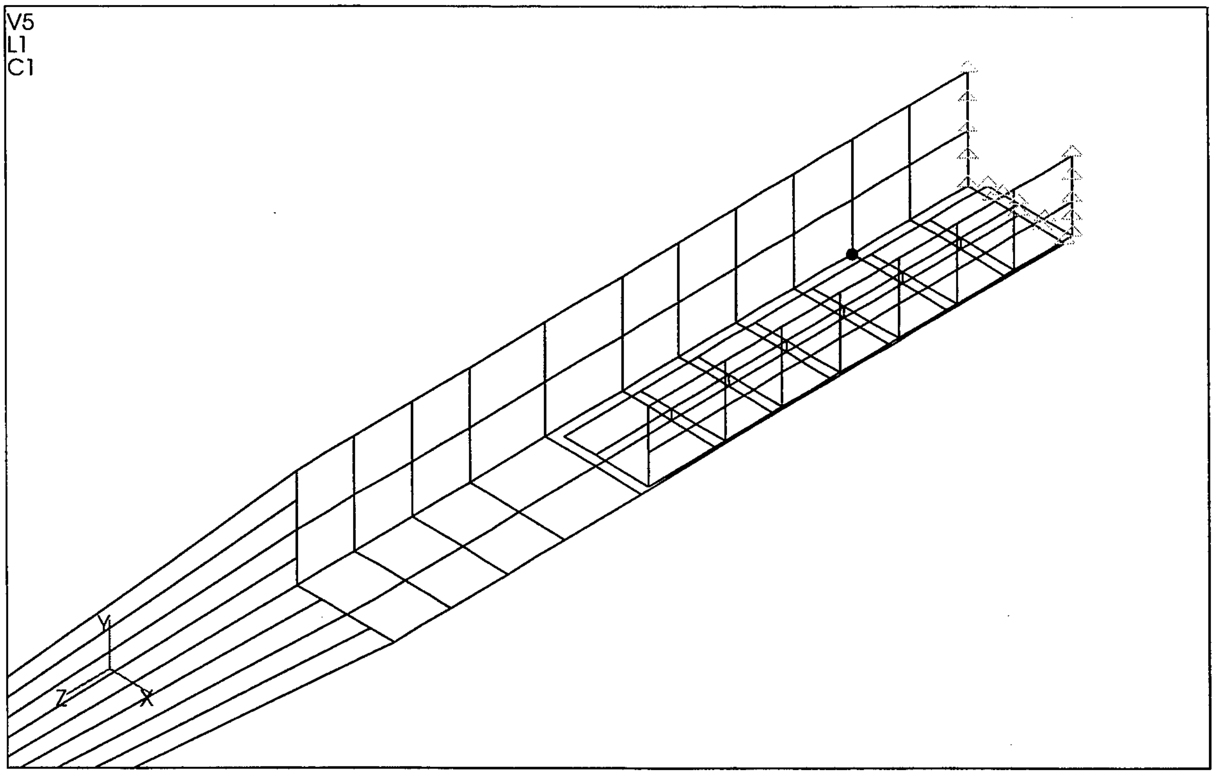


FIGURE 4-11 PSE W3 NASTRAN FINITE ELEMENT MODEL

The large disparity in results of the two models is explained by the fact that the NASTRAN model considers the true shape of the angles and accounts for local deformation near the fastener holes. The Excel model considers only the gross deformation of the axial bar elements. The fasteners thus see a stiffer structure in the Excel model.

Stresses during flight and taxi conditions were taken from strain gage measurements on the lower skin at WS 33 (Table D-10 of reference 1). Stresses during landing impact were obtained from gage 22 (Table D-8 of reference 1), located on the rear spar lower surface at WS 36. To convert stresses to applied loads in the aluminum angle, the stresses were multiplied by the area of the angle's lower flange.

The growth of a 0.05- x 0.05-inch corner crack at the last fastener hole in the angle was calculated using NASGRO crack cases CC02 (which reverts to TC03) and TC11. Continued growth of a 0.005-inch through crack on the other side of the hole quickly becomes unstable, as predicted by crack case TC02. The total life of the angle, as shown in Figure 4-12, is about 6,000 schedules or 33,000 hours. The critical crack length at this point is 0.44 inch.

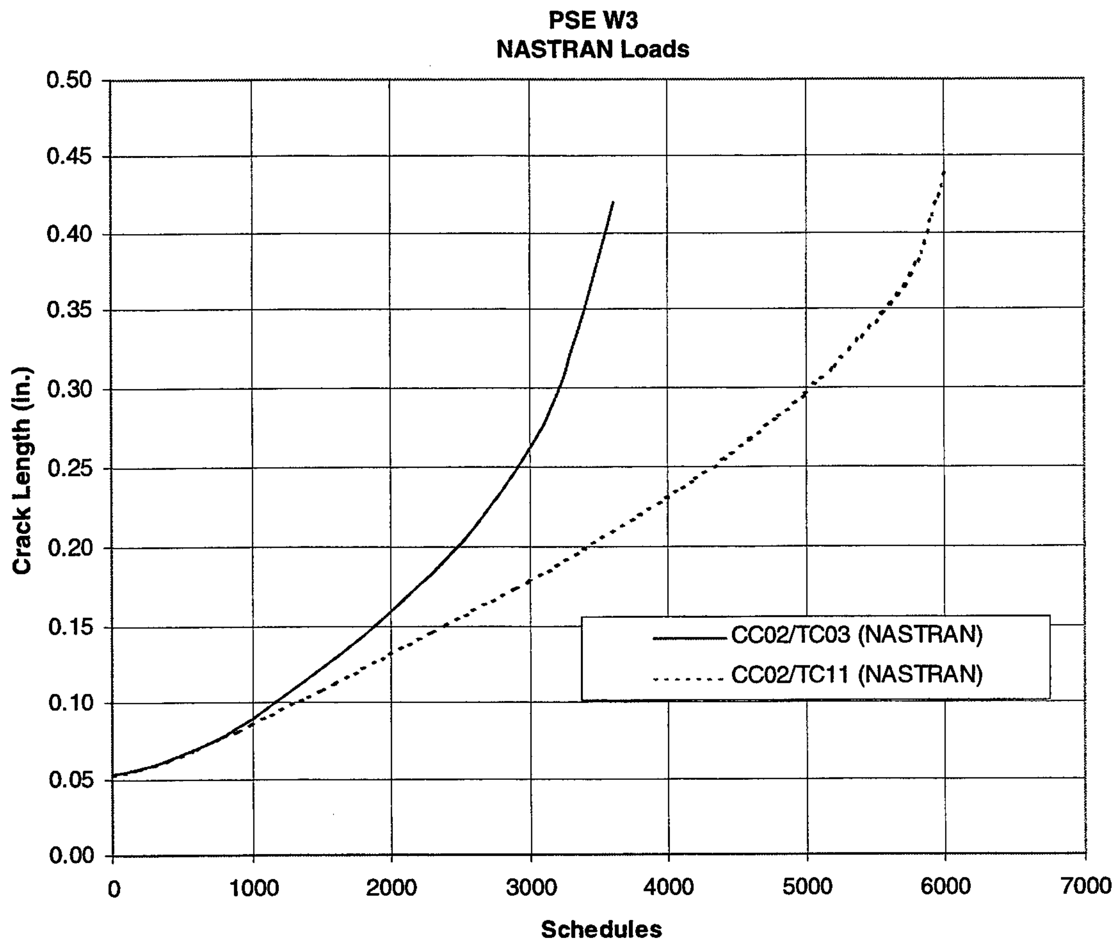


FIGURE 4-12 PSE W3 SA226 REAR SPAR LOWER CAP AT WS 27.0

Failure of this spar cap angle does not represent complete failure at this location. There is additional load carrying material including the angle on the forward side of the spar and titanium straps also on the forward side. However, since the angle is relatively easy to inspect, the intervals will be based on visual inspection of the short ligament of the aft angle. The threshold would therefore be 3000 schedules (16,500 hours) while the repeat inspections could be as long as 850 schedules (4,675 hours) apart. The Airframe Airworthiness Limitations Manual currently requires inspections beginning at 29,000 hours and every 2,000 hours thereafter. A repeat interval of 2,000 hours will be used in the SID.

After 96,500 hours of the full-scale fatigue test, a crack was discovered in the lower flange of the aft spar angle at WS 27. The crack had propagated from the second to last fastener hole, completely through the lower flange, and 0.38 inch up the upper flange. This crack was monitored for the remainder of the test and had grown an additional 0.22 inch up the upper flange at 104,000 hours. However, the crack did not result in spar failure at limit load, which demonstrated the fail-safety of the design [5]. Fail-safety was also shown by analysis [11].

Figure 4-13 shows that an average quality flaw in the angle reaches critical size after about 17,500 schedules (96,250 hours). This result closely matches the fatigue test result previously quoted, providing additional confidence in the analysis method.

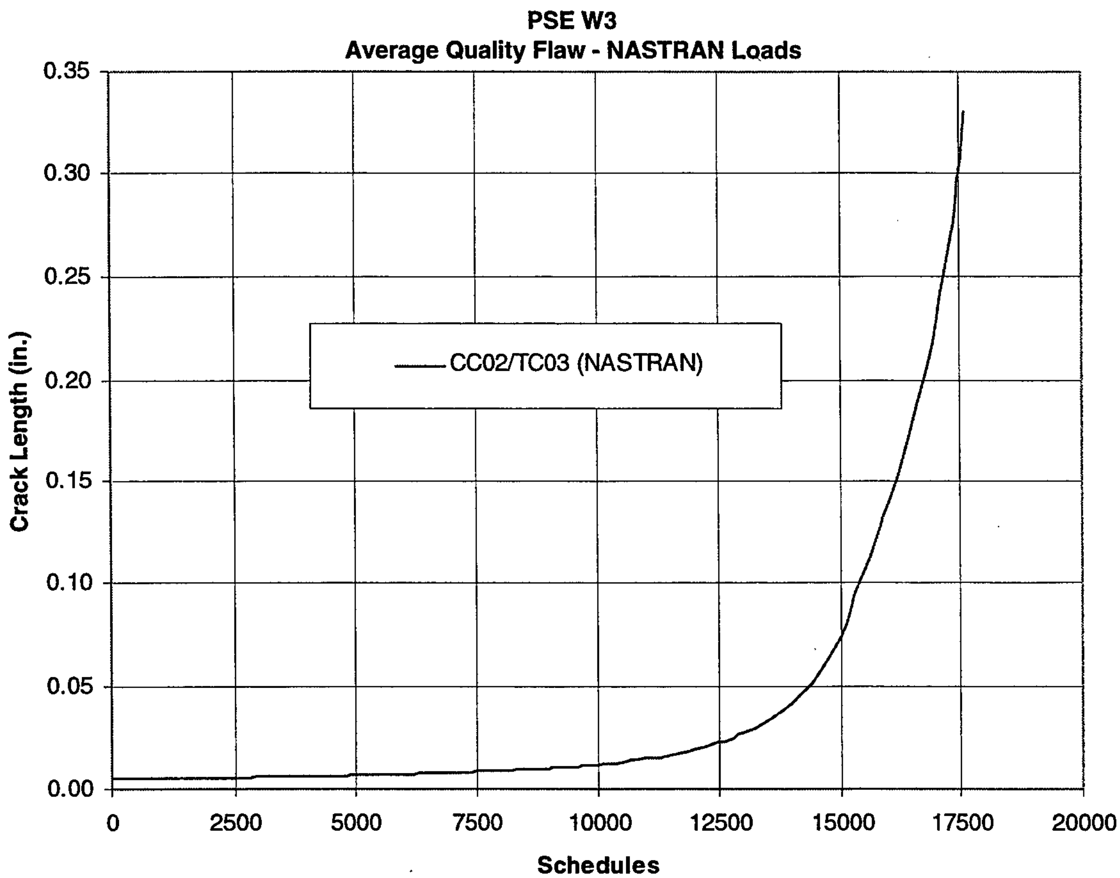
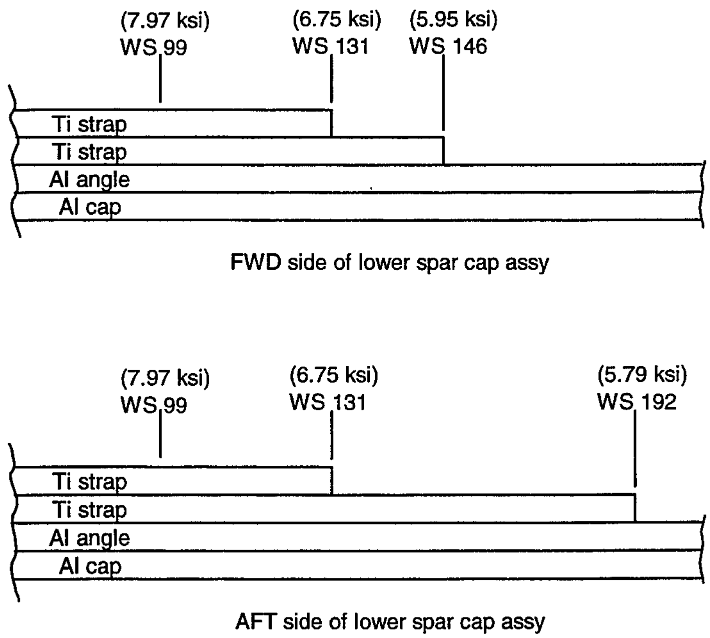


FIGURE 4-13 GROWTH OF AVERAGE QUALITY FLAW IN W3

4.4 PSE W4 SA227 MAIN SPAR LOWER CAP AT WS 99.0

The SA227 wing is a derivative design of the SA226 wing. The span of the SA227 wing was increased ten feet by adding a 5-foot tip extension to each side. To carry the larger bending loads, the SA227 main spar was strengthened by extending the titanium straps several feet outboard of station 99 (where the straps end on SA226 aircraft). In addition the straps' width and thickness was tapered over the last several inches to avoid large bearing loads at the last fastener in each strap. Figure 4-14 shows the configuration of the straps, along with the stresses in the cap where the straps end. The stress is still a maximum at WS 99 due to the nacelle cutout. However, there are potential hot spots at stations 131, 146, and 192 due to the end of titanium straps there.



(ref 27-31000 rev AB sht 4)

FIGURE 4-14 SA227 MAIN SPAR LOWER CAP ELEMENTS (1-g STRESSES FROM FIGURE 4-15 DATA)

To determine the necessary frequency and extent of inspections, crack growth analyses have been performed at WS 99, WS 130, and WS 146. (WS 192 did not have to be analyzed because the life at WS 146 was 100,000 hours.) Figure 4-15 shows the 1-g and per g stress distribution in the SA227 main spar for 14,000 lbs MTOW. It was obtained by adjusting the SA227 finite element analysis in reference 6 to fit stress measurements from the SA227 made during the Phase I strain survey [1].

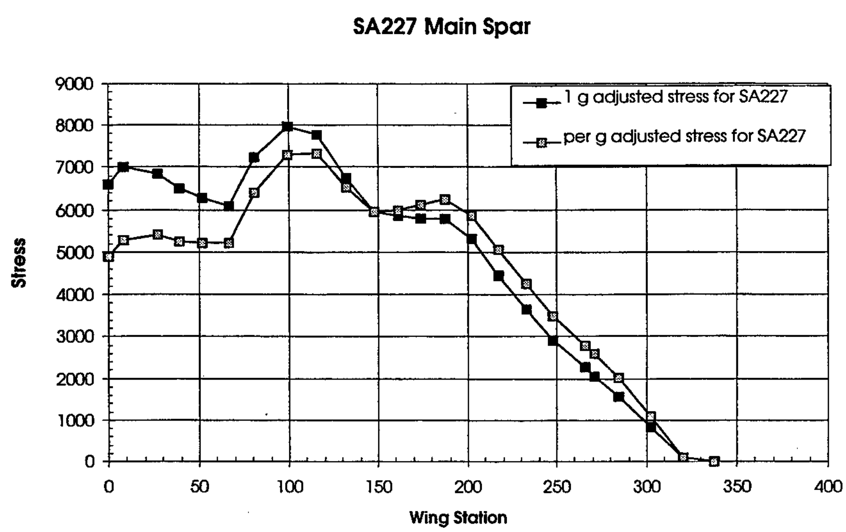


FIGURE 4-15 SA227 MAIN SPAR STRESS DISTRIBUTION (14,000 lbs MTOW)

The stress at landing impact is also known from readings at gage 23 of reference 1. Finite element analyses of the spar cap assembly show that the fastener load is about 2% of the load in the cap at WS 99, 10% of the load in the angle at WS 130, and 20% of the load in the angle at WS 146. The growth of 0.05- x 0.05-inch corner cracks in these members has been analyzed with NASGRO crack cases CC02, TC11, and TC12. Results are displayed in the following chart.

The curves in figure 4-16 are for rouge corner cracks growing from a fastener hole to the edge of the part, followed by the continued growth of a 0.005-inch through crack on the opposite side of the hole. Clearly the cap at station 99 is the critical member. Modified crack cases TC11 and TC12 predict that the life of the cap is about 7,414 schedules (40,777 hours), at which time the critical crack length is about 1.0 inch. The remaining structure in the SA227 cap assembly at WS 99—two aluminum angles and four titanium straps—is more than adequate to carry limit load in the absence of the cap, as shown by previous analysis [11].

To justify inspection of the aluminum members for complete crack through only, the growth of a 0.005-inch secondary flaw at WS 99 has also been analyzed. When the cap fails and the remaining angles assume a portion of the excess load proportional to their percentage of area in the assembly. Once this load transfer takes place, no further load transfer is considered, although the angle loses stiffness due to its crack as well.

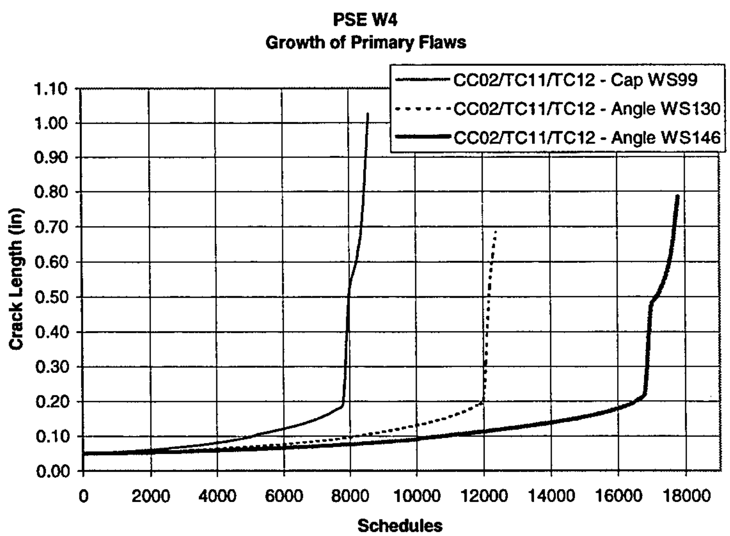


FIGURE 4-16 PSE W4 SA227 MAIN SPAR LOWER CAP PRIMARY GROWTH

Figure 4-17 shows that approximately 77,000 hours elapse between the cap and angle failures at WS 99. The inspections of the accessible surfaces of the spar should extend from a few inches inboard of WS 99 to a few inches outboard of WS 130 – a total of about three feet. The inspection threshold may be set at 20,000 hours, with an arbitrary repeat interval set based upon convenience. The repeat interval might be set at 5,000 hours or 5 years.

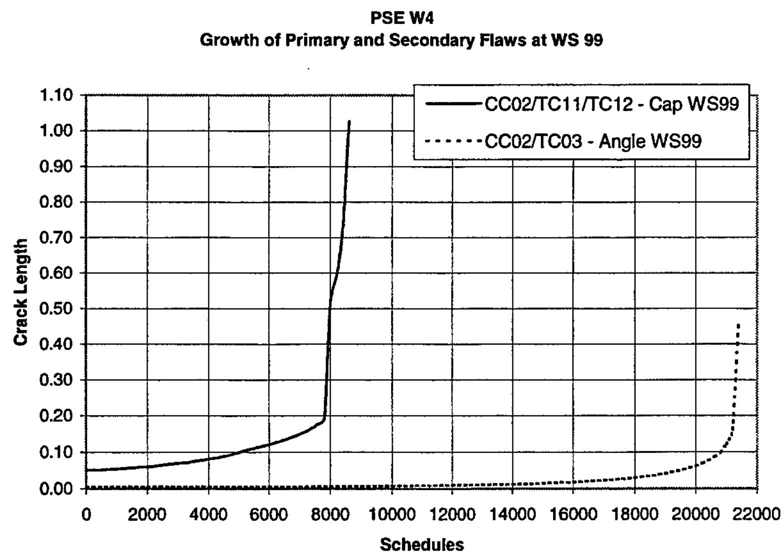


FIGURE 4-17 GROWTH OF SECONDARY FLAW AT WS 99

4.5 PSE W5 SA227 SKIN SPLICE AT WS 99.51 LOWER SURFACE

The wing lower skin between the spars is spliced at wing station 99, with the thickness increased inboard from 0.032 to 0.063 inch. The splice is achieved by a 0.050-in shim, a 0.063-in angle, and the 0.071-in wing rib. There is in addition an irregular shaped 0.032-in shim, which does not span the splice but serves to even out the load distribution in the outboard skin. The critical locations are the first fasteners in the inboard and outboard skins. Figure 4-18 shows a schematic of the splice.

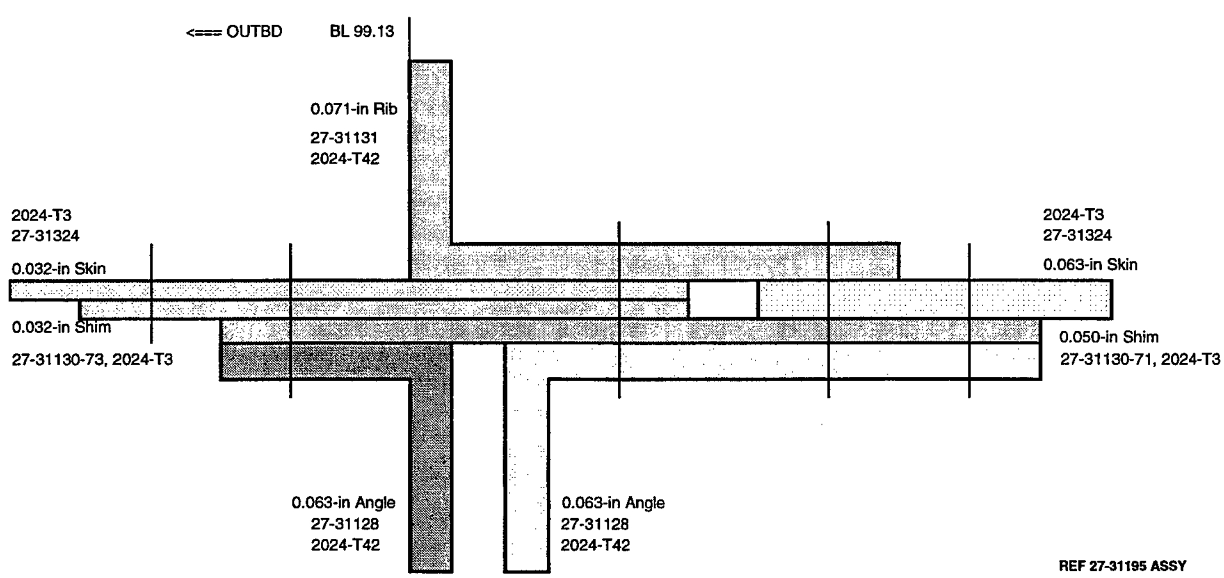


FIGURE 4-18 SCHEMATIC OF SPLICE AT WS 99 LOWER SURFACE

A finite element model was constructed in Excel for both the inboard and outboard skins. In both cases the members were modeled as 0.8-inch chordwise strips with a spanwise fastener pitch of 0.625 inch. The models indicate that the bearing load is more severe in the inboard skin due to the larger thickness change at this location. Specifically, 39% of the applied load in the inboard skin is transferred to the first fastener while only 24% of the load in the outboard skin is transferred to its first fastener.

The stress at WS 99 is obtained from Table E-11 of reference 1. This table lists corrected stresses at the main spar lower cap, WS 99. When these stresses are multiplied by the respective skin areas, the resulting loads provide the input stresses for NASGRO. NASGRO case TC05 was used to analyze the crack growth for both skins. The shortest life occurs in the 0.063-in inboard skin, where the 0.05-in crack is predicted to reach a neighboring hole at about 11,800 schedules, or 64,900 hours. At this point the crack length is 0.64 inch (the distance between the edges of neighboring holes). Crack growth curves for the skins are shown in Figure 4-19.

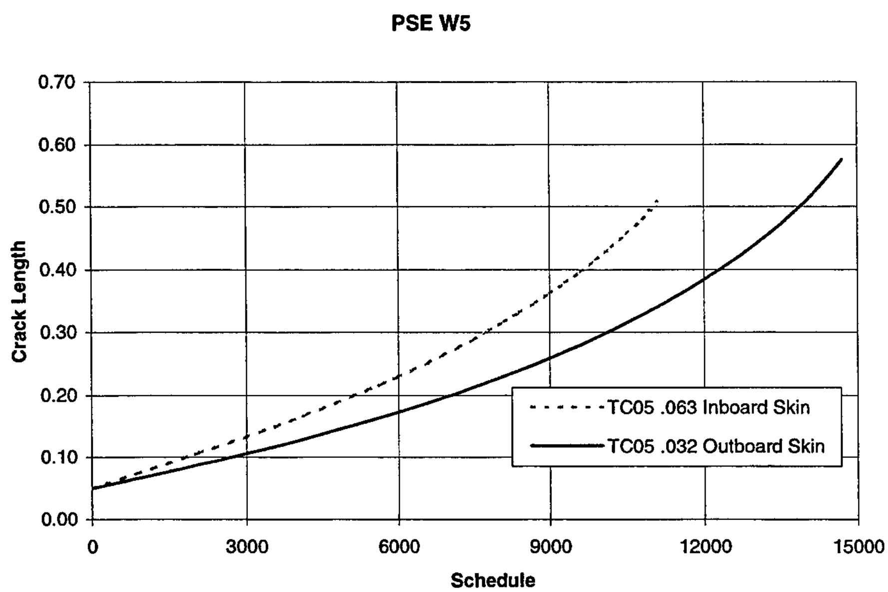


FIGURE 4-19 PSE W5 SA227 SKIN SPLICE AT WS 99 LOWER SURFACE

The inspection program for this splice depends on the growth after the crack links the first two holes together. As the crack grows a fuel leak is likely to develop which would be found during an overnight service check or pilot walkaround. Continued growth of a crack in the splice was modeled by considering the linked holes as a center crack in an infinite panel (NASGRO case TC01). Bearing loads from fasteners in the real splice were accounted for by increasing the remote stress in the infinite panel. The crack was allowed to grow until it was long enough to link another pair of holes. At that time the analysis was restarted to include the length of four linked holes. The model assumes an initial 0.05 flaw in one hole, and 0.005 inch secondary flaws on the opposite sides of the linked holes.

Figure 4-20 demonstrates that a crack in the splice reaches 2.0 inches after 13,800 schedules (75,900 hours) and a critical length of 3.5 inches after 14,300 schedules (78,650 hours). Thus the crack is longer than two inches for more than 2,500 hours before it reaches critical size. Since a crack of two inches or more is very likely to cause a fuel leak, the normal maintenance checks can be relied upon to detect fatigue damage to the splice. Should a leak not be evident initially, page 63 of [R771] and page 1.54 of [R190] show that the wing is fail-safe with the skin between adjacent stringers missing (a length of 7.8 inches). At this crack length a leak is virtually certain to occur.

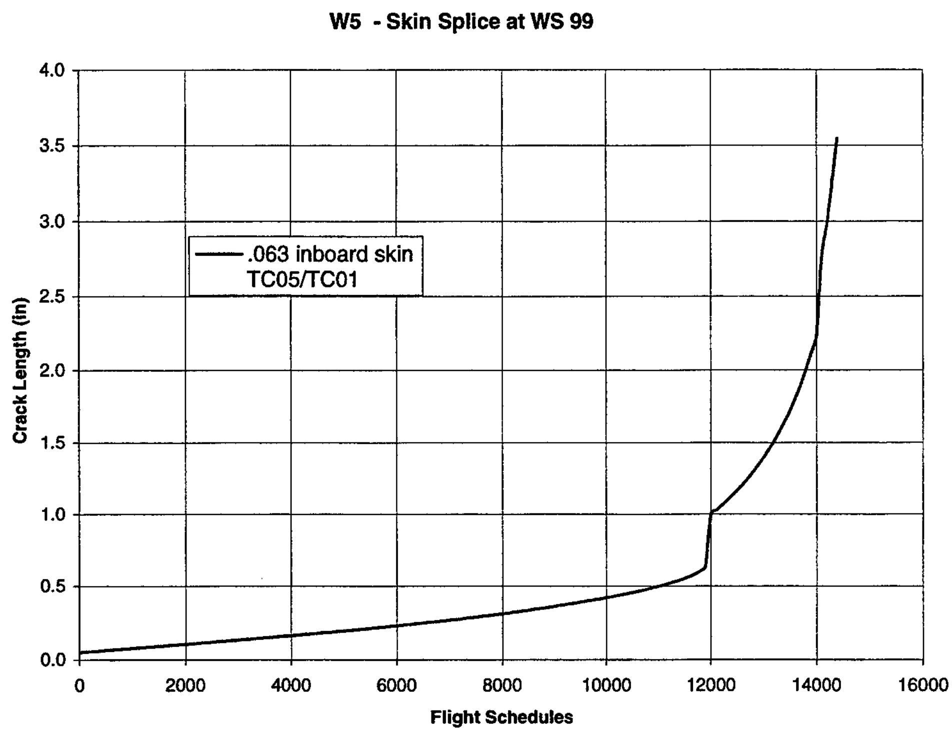


FIGURE 4-20 CRACK IN WS 99 SPLICE LINKING ZERO, TWO, AND FOUR HOLES

4.6 PSE W6 SA227 WING EXTENSION FITTING, MAIN SPAR LOWER SURFACE

The steel fitting on the wing extension is sandwiched on the inboard side between two other steel fittings on the main spar. On the outboard side it is attached to the outboard continuation of the main spar by two straps, two angles, and a doubler. There is a relatively large stress concentration where the first fastener connects the splice plates to the steel extension fitting. Figure 4-21 shows the output of the Excel stiffness model for a unit load applied to the fitting. Shown are internal loads between nodes and fastener loads at the nodes.

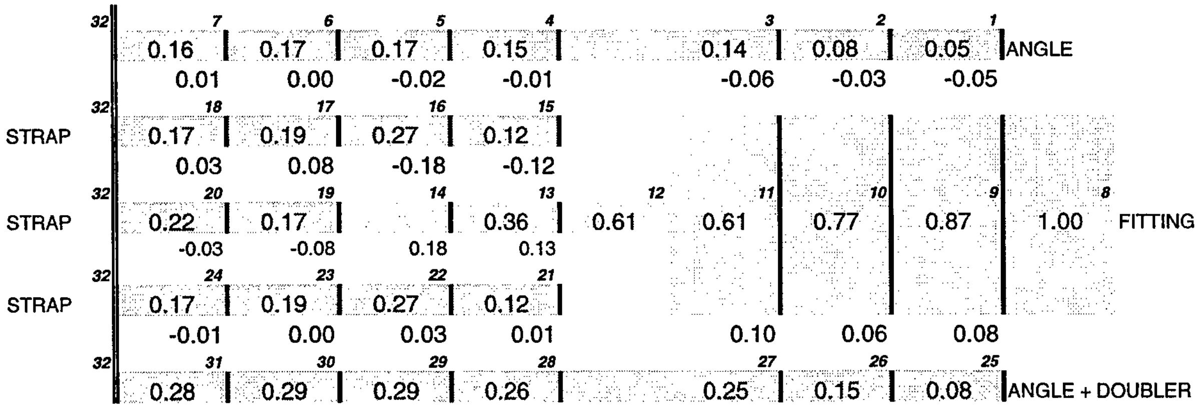


FIGURE 4-21 PSE W6 LOAD DISTRBUTION IN STIFFNESS MODEL

For the stiffness model, the worst case is in the 0.071-in-thick 2024-T3 strap at the first (farthest outboard) fastener in the extension fitting. At this location the fastener bearing load and strap internal load are 15% and 12%, respectively, of the load in the fitting. The load in the fitting is found from the product of the stress at Gage 25 (reference 1) and the area of the 1.38-inch-wide spar cap and the two horizontal legs of the spar cap angles. This applied load, for the 1-g condition, is 462 lbs. This results in a total stress of 6 ksi in the strap. At this stress level, the crack growth life as calculated by NASGRO case TC03 and shown in Figure 4-22 is well in excess of 80,000 schedules (440,000 hours).

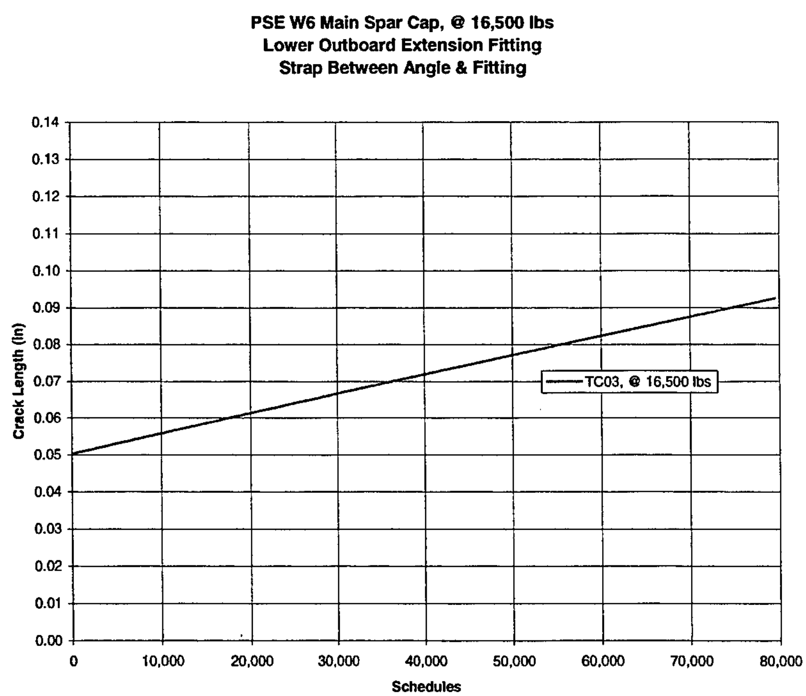


FIGURE 4-22 PSE W6 SA227 WING EXTENSION FITTING MAIN SPAR LOWER SURFACE

4.7 PSE W7 SA227 LOWER WING SKIN ON FORWARD SIDE OF MAIN LANDING GEAR TRUNNION AT WS 113

At PSE W7, the landing gear trunnion support angle ends abruptly creating a stress concentration in the lower wing skin and stringer. One operator reported a crack at 11,052 hours in the skin and stringer 19 at the last fastener through the trunnion support angle [10]. The crack was discovered because the rivet sheared off, which caused a noticeable fuel leak. Beginning with station number S/N 847, the design detail was changed by increasing the taper of the trunnion angle and adding a spanwise strap to cover the affected skin area.

The load distribution in the original design has been estimated by developing an Excel stiffness model and NASTRAN finite element model for comparison. The NASTRAN model is very similar to the one shown in Figure 4-11 for PSE W3 but was tailored for this PSE. It predicted that the last fastener load is 20% of the applied load in the stringer. The Excel model, which considers only the horizontal leg of the trunnion angle, predicted that the last fastener load is 23% of the applied load in the stringer. The complete analysis is presented in Appendix A.

The applied load in the stringer outboard of the trunnion angle is found by considering the stress in the main spar at WS 113. This is assumed to closely approximate the stress in the skin panels (and stringers) between the spars. From Figure 4-15 it is apparent that at WS 113, the 1-g stress is 7.9 ksi while the stress per g is 7.4 ksi. The applied load is found using these stresses and the area of the stringer flange.

NASGRO crack case TC03 predicts the life of a 0.05-in crack growing in the stringer from the last fastener hole. Figure 4-23 shows that after about 3,100 schedules or 17,050 hours the flow stress of the stringer is exceeded. At this point the critical crack length in the stringer is 0.17 inch.

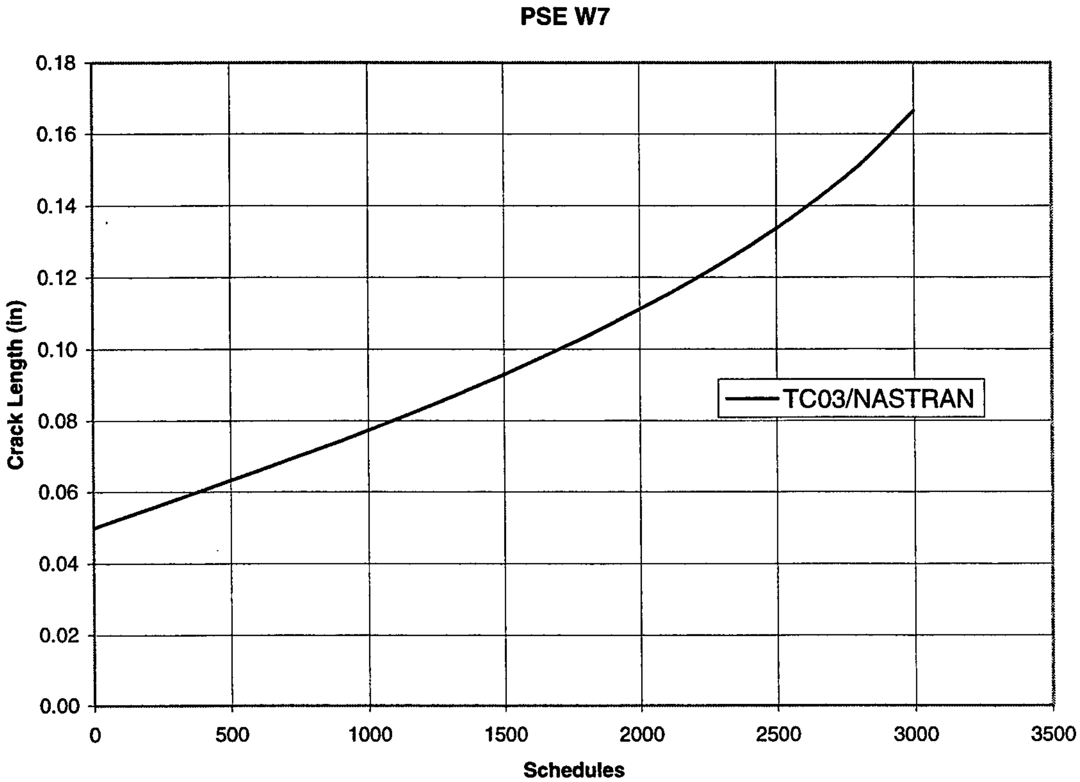


FIGURE 4-23 PSE W7 SA227 LOWER WING SKIN FWD SIDE OF LANDING GEAR TRUNNION AT WS 113

The stiffened panels on the lower wing have been shown fail-safe in the event of stringer failure (see page 11.0 of [11]). Continuing damage in the skin is considered here, however. Once the stringer fails, its load will be transferred to the skin. If the skin between the remaining stringers is assumed fully effective, then the load in the skin will increase by 25% (based on an area ratio of $A_{stringer}/A_{skin} = 0.25$). In addition, the trunnion angle will cause a very large stress concentration in the skin. The analysis given in Appendix A shows that the load transfer at the last fastener in the angle is about 44% of the load in the skin. The effect of these loads on the growth of a 0.05-inch flaw in the skin is shown in Figure 4-24. The crack does not reach its critical size of 4.75 inches until more than 220,000 hours have elapsed. By this time a fuel leak would almost certainly be evident.

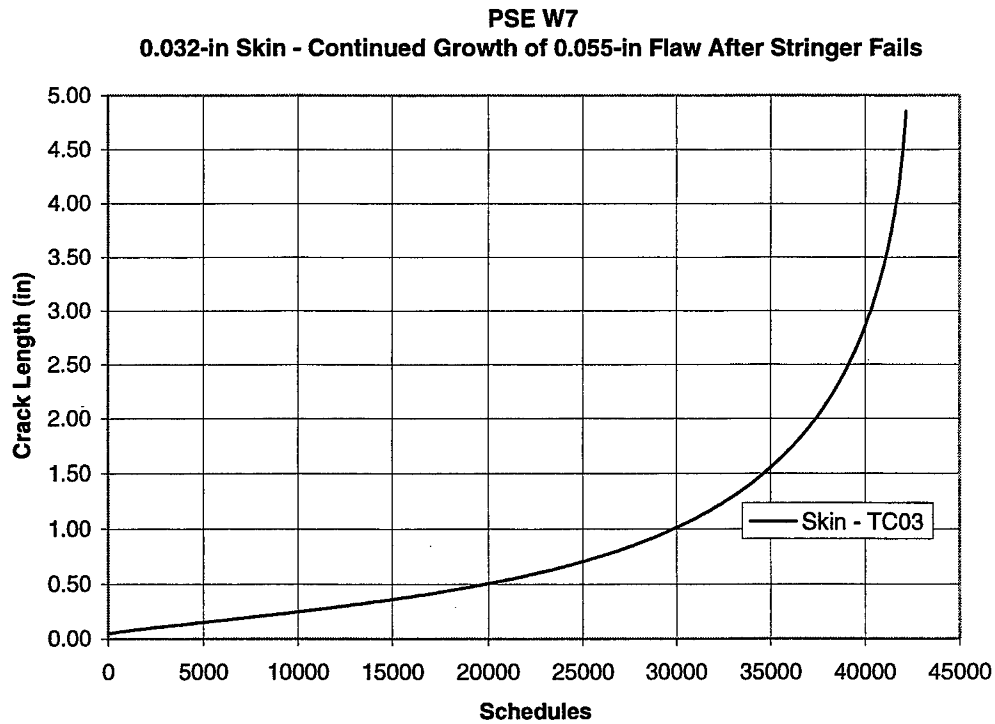


FIGURE 4-24 PSE W7 CONTINUING DAMAGE IN 0.032 SKIN

4.8 PSE W8 SA226 AND SA227 CHORDWISE SKIN SPLICE AT WS 173.9 LOWER SURFACE

PSE W8 near the rear spar consists of a butt splice of the 0.025-in outboard skin to the 0.032-in inboard skin with a 0.032-in splice plate. Both skins are 2024-T3 sheet. The critical location analyzed was along the outboard row of fasteners through the splice plate and 0.025-in outboard skin. Referring to Figure 4-14, the 1-g stress is 5.8 ksi and stress per g is 6.2 ksi in the main spar at this wing station. Reference 6 indicates that the stress in the rear spar at this wing station is about 15% less. For landing, the stress measured by gage 24 at the rear spar WS 106.2 [1] was taken to account for stresses near the splice at landing impact. The 1-g taxi load was arbitrarily taken as –1000 psi, as significant tension loads are unlikely in this region during taxi roll.

To determine the load transferred to the plate by each fastener in the first row, a simple stiffness model was constructed similar to others in this report. The skin and plate are represented as axially loaded strips having widths equal to the chordwise fastener spacing. Along the strip the 1/8-inch rivets are spaced by 0.73 inch. This model predicted a first fastener load of 48% of the applied load in the skin.

NASGRO crack case TC05 (Figure 4-25) predicted that a 0.05-in through crack in the outboard skin becomes unstable after about 32,000 schedules (176,000 hrs). At this time the crack has grown to a size of 0.47 inch and fuel leakage should be evident.

PSE W8

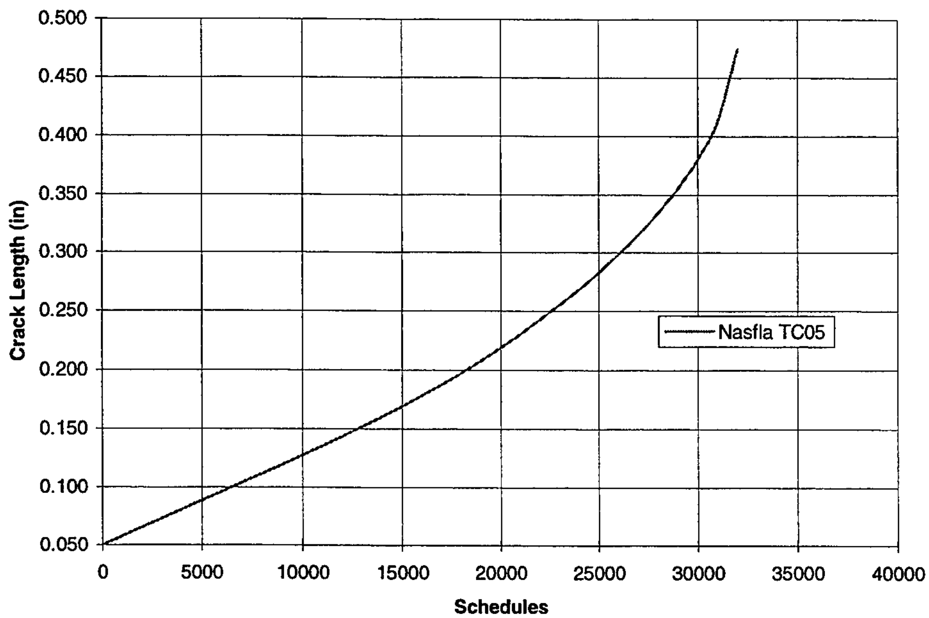


FIGURE 4-25 PSE W8 CHORDWISE SKIN SPLICE AT WS 173.9

4.9 PSE W9 SA226 AND SA227 SKIN SPLICE AT WS 27 LOWER SURFACE OUTBOARD OF RIB

A sketch of PSE W9 is shown on page 6-22 of reference 1. By inspection it is clear that the critical location in this lap splice is in the belly skin where the wing skin and splice strap terminate. At this location the belly skin is 0.050-in thick and must assume load both from the 0.063-in wing skin as well as the 0.071-in steel splice strap. The wing skin is less critical because it is thicker and must transfer load only to the steel strap at the first fastener. The rib attached to the outboard skin does not participate in the splice.

From the above discussion, the crack growth life of PSE W10 can be used as the minimum life for PSE W9. The analysis of PSE W11 will consider potential cracks at the 0.050- to 0.100-in thickness change of the belly skin.

4.10 PSE W10 SA226 AND SA227 SKIN SPLICE AT WS 27 LOWER SURFACE INBOARD OF SPLICE

Continuing the analysis from PSE W9, a finite element stiffness model was developed to determine the distribution of loads in the splice. The complete model is given in Appendix A but the results for the unit load case are shown here in Figure 4-26. These confirm the discussion given for PSE W9 and show that the highest bearing load is in the inboard fastener.

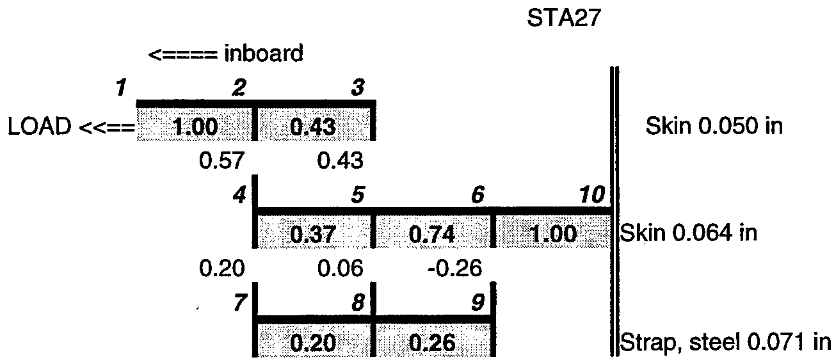


FIGURE 4-26 PSE W10 FINITE ELEMENT MODEL OUTPUT

A crack was observed in the belly skin at this location after 88,872 hours of the SA226 fatigue test [5]. For comparison, NASGRO crack case TC05, based on 1-g gross stress of 4.6 ksi and stress per g of 6.8 ksi (Table E-12, reference 1), predicts the crack growth shown in Figure 4-27. The 0.05-in through crack has grown to an adjacent hole in the splice after 3,300 schedules (18,150 hrs) of spectrum loading. At that time the crack is about 0.4 inch long.

To calculate continued growth after the first two holes have linked together one can assume the presence of 0.005-inch cracks on the opposite sides of the linked holes. NASGRO case TC01, representing the linked holes as a center crack in an infinite panel, has been used to study this case. Bearing loads from fasteners in the real splice are accounted for by increasing the remote stress in the infinite panel. The analysis is stopped and restarted after the crack reaches a second pair of holes. The figure shows the results of this process. No appreciable life is attained after four holes have been linked together by the crack. The total life at that point is about 23,650 hours.

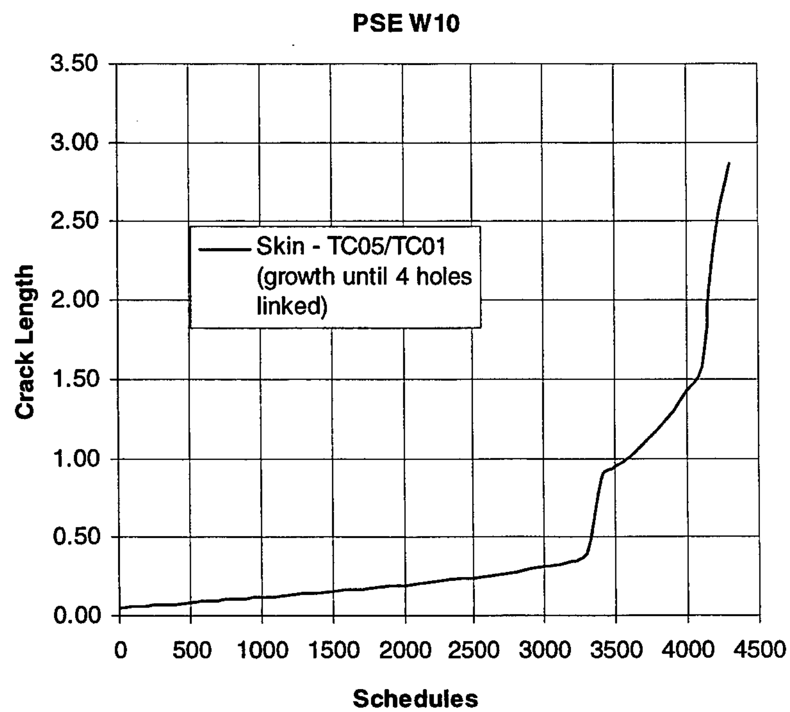


FIGURE 4-27 PSE W10 SA226 AND SA227 SKIN SPLICE AT WS 27 INBOARD

The results just presented dictate a relatively short inspection threshold of 11,800 hours. The repeat interval may be set at 5,500 hours for an eddy-current inspection capable of detecting a crack that links two holes. During the fatigue test the crack at this location (mentioned above) grew to a length of over 20 inches without causing other failures in the wing. This provides evidence of the fail-safety of the design and substantiates a long repeat inspection interval.

4.11 PSE W11 SA226 WING LOWER CENTER SECTION SKIN AT LANDING LIGHT CUTOUT

PSE W11 continues the analysis of the lap splice at wing station 27 begun for PSE W9 and W10. On SA226 aircraft the splice strap ends several inches forward of the rear spar and therefore the fastener loads are lessened. However, a gross stress concentration exists in the region due to the presence of a large landing light cutout inboard of station 26. (The landing light was moved on SA227 models.) In addition, the belly skin is chemically etched to 0.050-in thickness at the splice causing a local stress concentration at the fillet. Production drawings indicate that the fillet radius is "as etched." For purposes of this analysis the fillet radius is assumed to be 0.020 inch.

During the SA226 full-scale fatigue test, the earliest crack in this region occurred at about 42,000 hrs and propagated chordwise along the thickness change in the belly skin. A similar crack occurred on the opposite side of the airplane much later. Both cracks originated at inboard fastener holes in the splice but grew away from the row of fasteners and stayed at the fillet [5].

Tables for the standard case of an axially loaded plate with symmetrical fillets on either side estimate K_t as 2.0 for this geometry [8]. A second estimate was obtained from the boundary element program NASBEM. The boundary elements in Figure 4-28 were subjected to a unit axial stress plus 20% bending. (Experimental results for PSE W1 given in Appendix E of volume II show that in that case the bending induced by fasteners in the splice was about 18% of the axial stress.) Results of the NASBEM analysis are plotted in Figure 4-29.

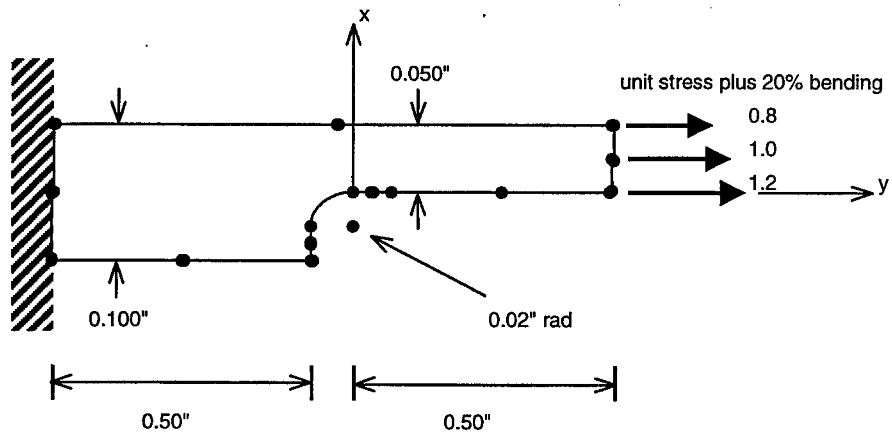


FIGURE 4-28 NASBEM BOUNDARY ELEMENT MODEL FOR PSE W11

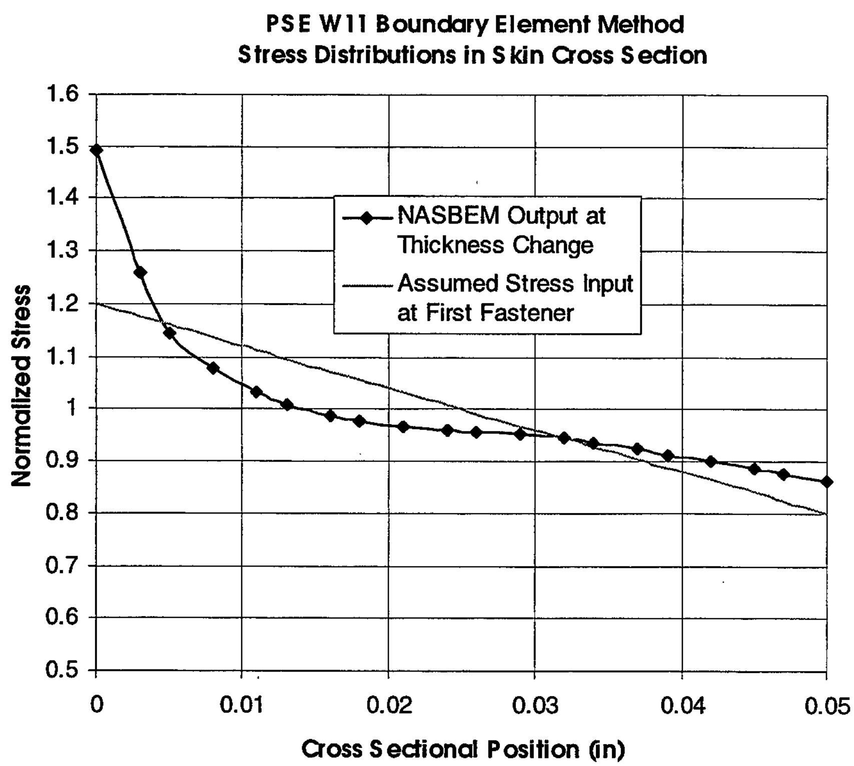


FIGURE 4-29 NASBEM OUTPUT AT FILLET IN PSE W11

The gross stress at the splice is assumed to be that at WS 27, as calculated in Table E-12 of reference 1 from fatigue test measurements at WS 33. In NASGRO crack case TC01, the panel width has been taken as 5 inches or the distance from the front of the rear spar to the aft end of the splice strap.

The NASGRO analysis based on K_t of 2.0 predicts a life of about 4,000 schedules or 22,000 hours. At this time the crack is 0.89 inch long. Growth predictions based on K_t of 1.5 and 2.0 are shown in Figure 4-30. Although the analysis predicts that the growth rate accelerates rapidly, in practice the growth rate appears to slow substantially when the crack reaches the lower stress region outboard of the landing light cutout. It is interesting to note, however, that a 33% increase in K_t results in a 75% reduction in predicted life. This highlights the importance of variations in load conditions and tolerances from aircraft to aircraft.

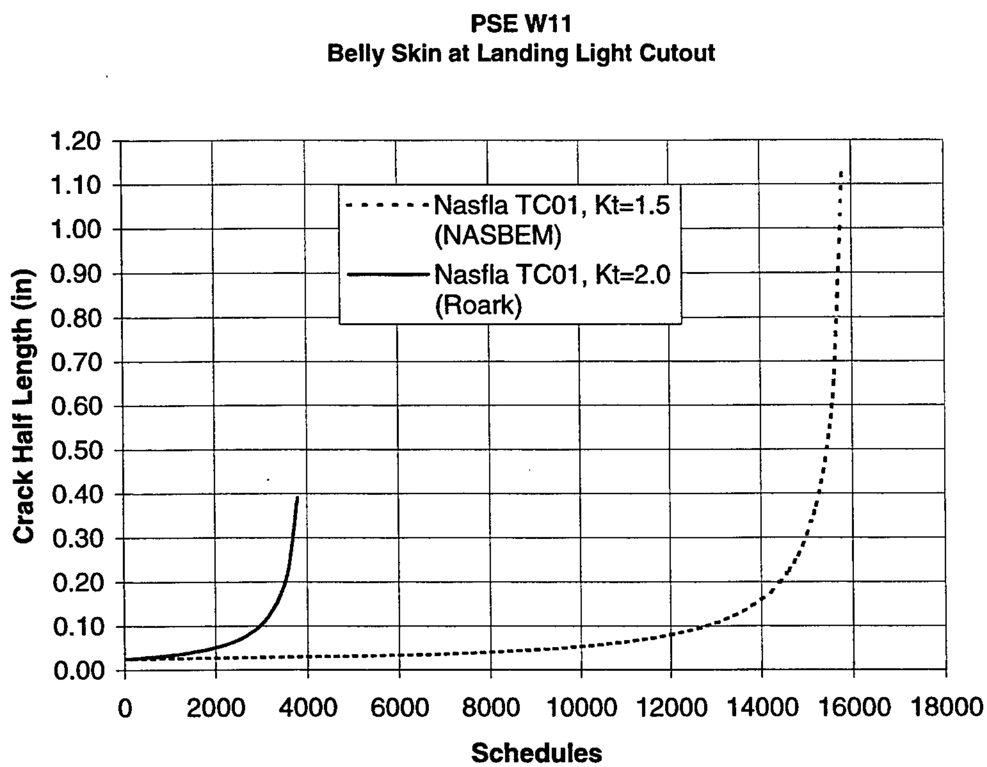


FIGURE 4-30 PSE W11 SA226 WING LOWER CENTER SECTION SKIN AT LANDING LIGHT CUTOUT

4.12 PSE W12 SA227 TIP EXTENSION FITTING, REAR SPAR LOWER SURFACE

The steel tip extension fitting is attached to the rear spar angle at PSE W12 by three NAS 6203 steel fasteners on aircraft with a gross takeoff weight of 16,000 pounds or less and by four fasteners on aircraft with a gross takeoff weight of more than 16,000 pounds. The steel fitting is stepped to reduce the stress concentration at the first fastener hole in the aluminum spar cap. A stress concentration still exists, however.

To calculate the load on the first fastener a finite element analysis was performed with an Excel spread sheet program using the methods described earlier in this report. The results are given in Appendix A. The stress per g for the important gust case is only 1239 psi maximum. At this low stress level, one can expect a long crack growth life.

The crack growth rate was calculated using NASGRO crack case TC03. The TC03 standard solution is conservative because it does not account for the additional area and moment of inertia in the leg of the angle that is not next to the steel fitting. Initially a through crack of 0.05 inch was assumed emanating from the loaded hole. The predicted life from the initial flaw is in excess of 165,000 hours or 30,000 schedules (see Figure 4-31). At this life the crack growth is almost negligible. This is true for both the three-fastener and the four-fastener fitting.

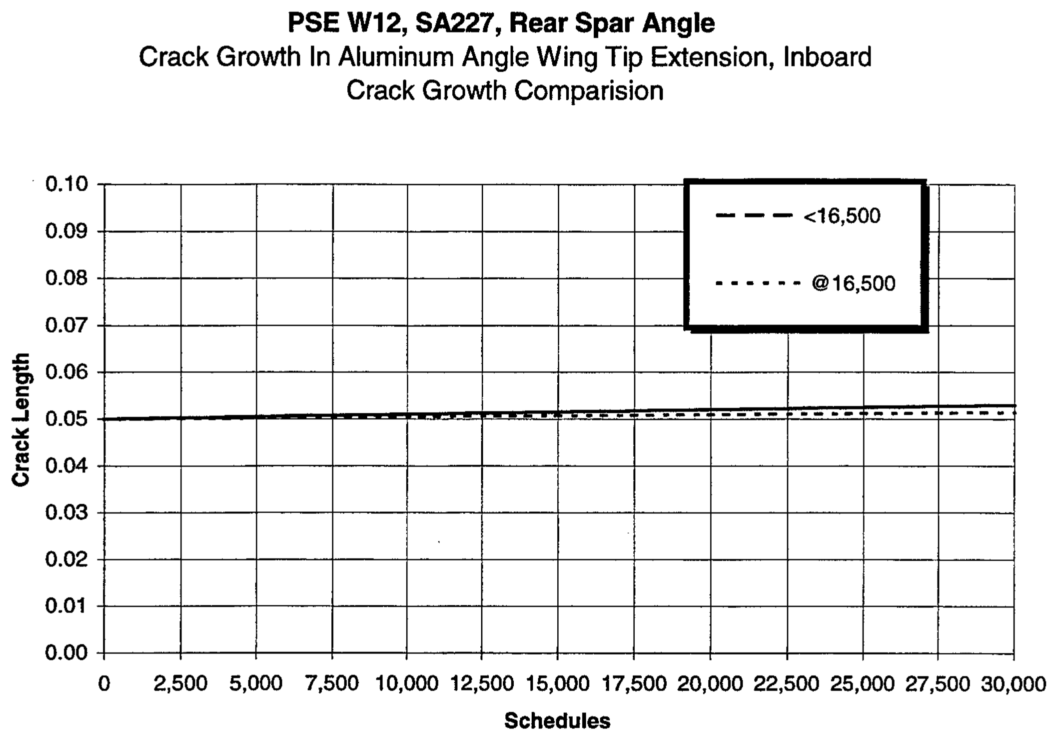


FIGURE 4-31 PSE W12 SA227 TIP EXTENSION FITTING REAR SPAR LOWER SURFACE

4.13 PSE W13 SA227 TIP EXTENSION AT END OF OUTBOARD FITTING, REAR SPAR LOWER SURFACE

The steel tip extension fitting is attached to the wing extension rear spar angle at PSE W13 by four steel fasteners. The steel fitting is stepped to reduce the stress concentration at the first fastener hole in the aluminum spar angle. A stress concentration still exists, however. To calculate the load on the first fastener a finite element analysis was done using an Excel spread sheet program by the method described earlier in this report. The results are given in Appendix A. Included are the

internal load and fastener load calculations for gust, landing, and taxi cases. The stress per g for the important gust case for this component is 2580 psi maximum. At this low stress level, one can expect relatively long crack growth life.

The crack growth rate was calculated using the NASGRO crack growth program standard solution for crack growth from an eccentric hole in a finite width plate (TC03). Initially a through crack of 0.05 inch was assumed emanating from the loaded hole in the 2024-T3511 extrusion. The predicted life from the initial flaw is in excess of 35,600 schedules (195,800 hrs). At this time the 0.05-in initial flaw had grown to about 0.28 inch. This behavior is driven largely by the fastener load that exists between the aluminum angle and the more stiff steel fitting. Figure 4-32 shows the crack growth curve for this PSE.

Since the predicted life of this critical area is greater than 50,000 hours with a scatter factor of 2, and there is no adverse service history, no supplemental inspection is warranted. In addition, the wing extension has been shown fail-safe by analysis [11].

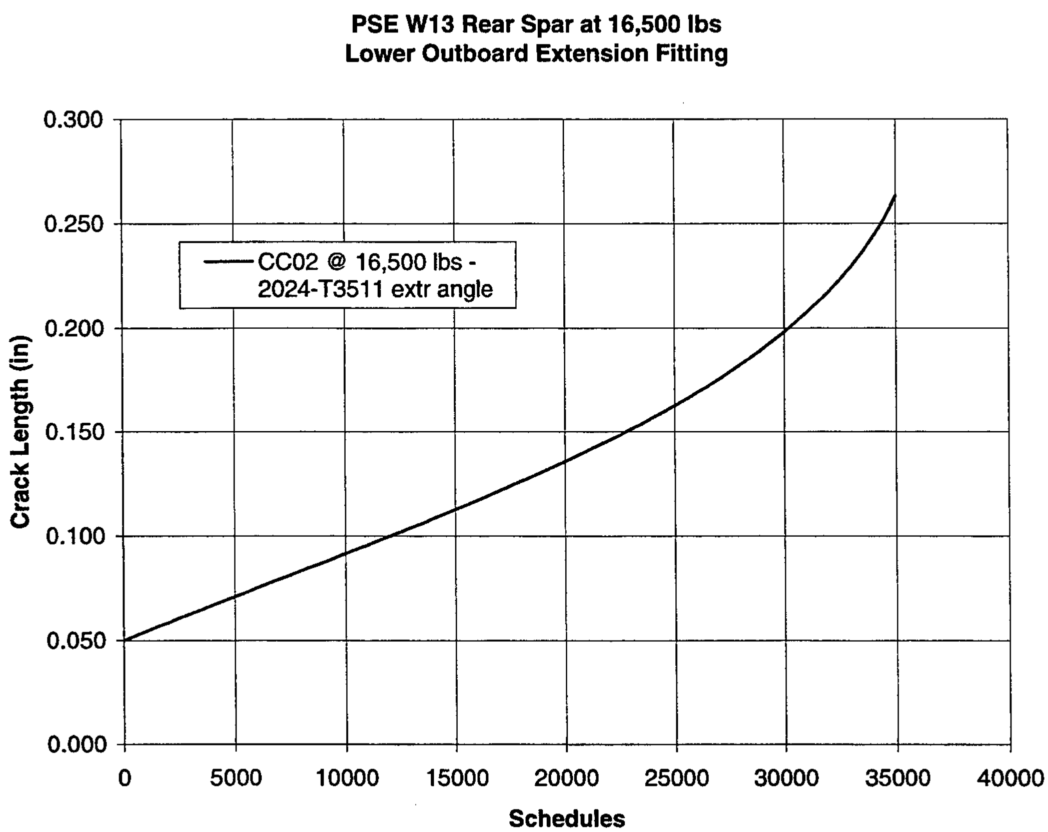


FIGURE 4-32 PSE W13 SA227 TIP EXTENSION AT END OF OUTBOARD FITTING REAR SPAR LOWER SURFACE

4.14 PSE W14 SA227 TIP EXTENSION AT END OF OUTBOARD FITTING, MAIN SPAR LOWER SURFACE

The main spar wing tip extensions for SA227 aircraft are attached to the main wing box by steel fittings at the main spar and at the rear spar. The main spar fitting consists of two steel lugs bolted to the main spar by four NAS 1103 steel bolts. The thickness of the fittings is stepped to reduce the stress concentration at the first fastener in the fitting. A finite element model of this configuration was developed using the stresses measured in the flight test program to define the loading. The results of this analysis show that the first fastener between the lug and the aluminum spar is the highest loaded location in the fitting. Because the stress measured in the aluminum cap at this location is on the order of 1 ksi, very slow crack growth is to be expected. Using the computed fastener load and spar cap stress the NASGRO crack growth program was run for the equivalent of 115,500 hours with the assumption of an initial through-the-thickness flaw of 0.05 inch. As expected there was no appreciable crack growth (see Figure 4-33).

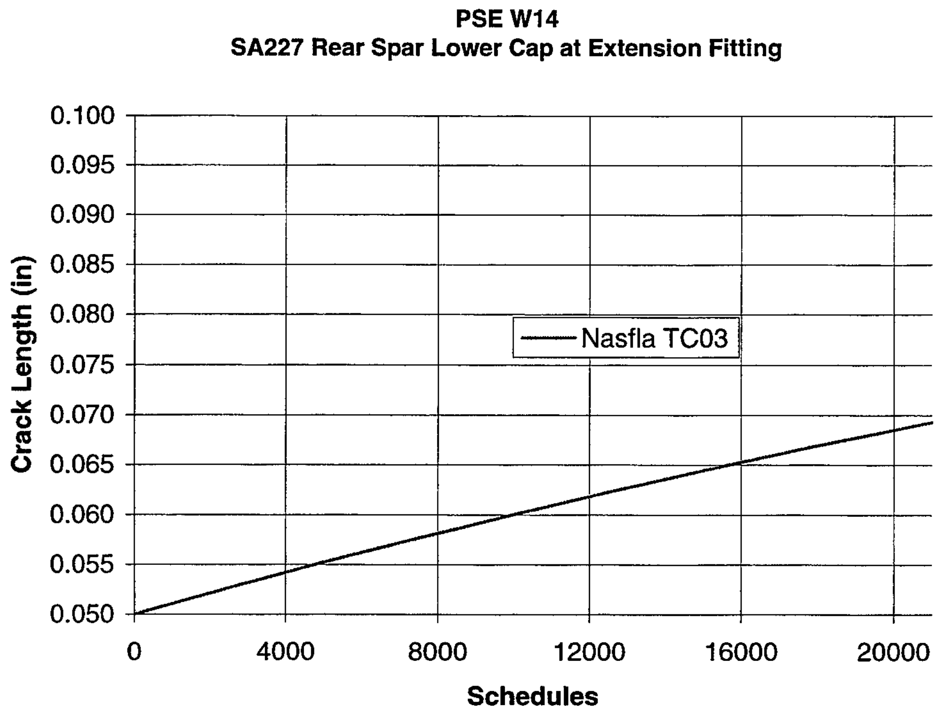


FIGURE 4-33 PSE W14 SA227 TIP EXTENSION AT END OF OUTBOARD FITTING MAIN SPAR LOWER SURFACE

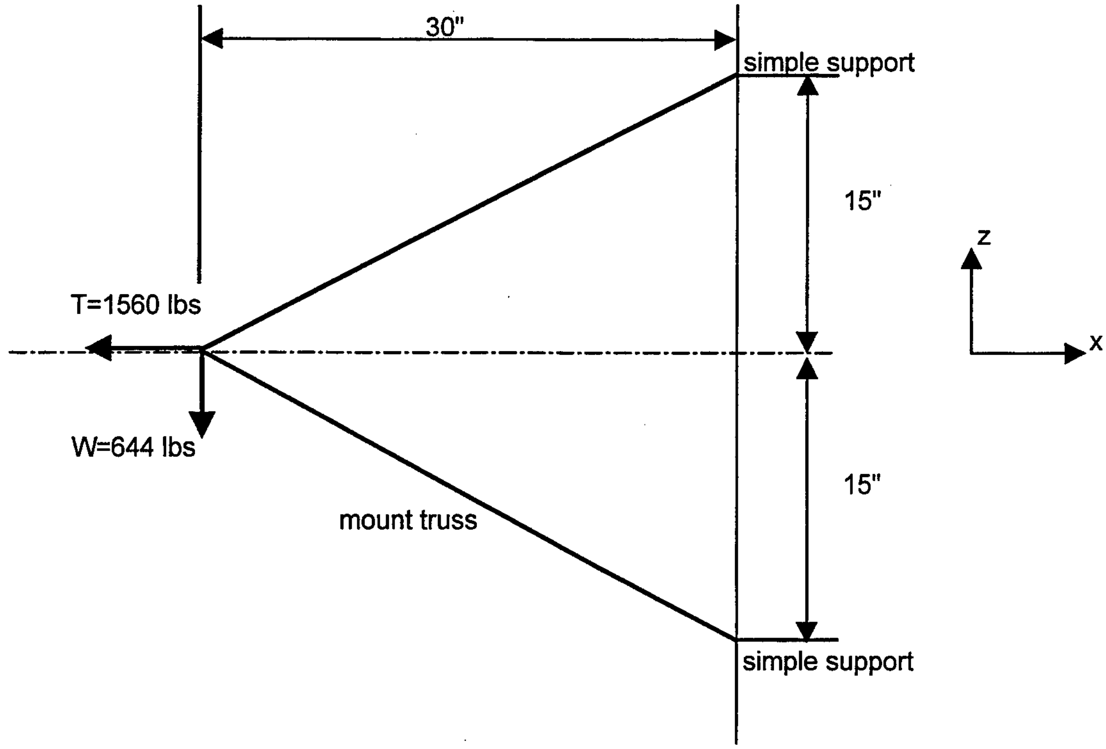
5. ENGINE MOUNT AND NACELLE GROUP

5.1 PSE EM1 SA227 UPPER ENGINE MOUNT (27-62114) AT THE FIREWALL

The engine mount is attached at the firewall with a bolt that passes through a 4130N plate welded to the end of the 4130N engine mount truss tubing. The plate on the end of the tubing is relatively thin—only 0.190 inch thick. On previous designs the washer under the head of the bolt had approximately the same diameter as the bolt head. Because the inside diameter of the tube is 1.35 inches and the head diameter of the bolt is 0.75 inch, bending stress developed in the plate when the bolt was loaded in tension. This bending stress has caused cracking in the plate at the edge of the washer on some aircraft. The stress due to bending can be difficult to calculate accurately and the detail is difficult to inspect. For these reasons, Service Bulletins (SB) (227-71-008 and CC7-71-001) were issued to change the design in the affected region by installing a larger, thicker washer in place of the original NAS143-7C washer. This new washer has an OD just smaller than the ID of the tube, thus reducing bending stress in the plate.

Four crack cases were analyzed: pre- and post-SB configurations for a 0.05-in circumferential through crack in the flange at the washer OD and a 0.05-in circumferential through crack in the weld joint. Given that some pre-SB mounts had failed, the effect of the service bulletin modification on crack growth life was estimated.

The load at the upper engine mount was determined by considering the mount truss as a statically determinate structure subjected to 644-lbs powperplant weight and 1560-lbs maximum continuous thrust. Figure 5-1 depicts this model. The applied loads result in upper mount loads of 1424 lbs at 1 g and 644 lbs per additional g. Ideally, each upper mount carries half of the load, but to allow for unanticipated effects, one mount was assumed to carry the entire load.



Sum moments about lower support:
30 Fx = 15 T + 30 W
Fx = 0.5 T + W

FIGURE 5-1 ENGINE MOUNT TRUSS

Case 1J , Table 24 in reference 8 was used to estimate stresses in the plate and weld. The model assumes that the washer and weld joint do not rotate. These are reasonable assumptions since the washer is clamped to the plate while at the weld joint several tubes converge. The analysis, given in Appendix A, shows that the critical case is bending in the plate near the washer OD. Increasing the washer OD by 60% (per the SB) decreases the plate stress by 80% and the weld stress by 65%.

NASGRO does not have material constants for 4130N steel. Instead, the constants for 160-180 UTS 4340 plate were modified by inserting yield and ultimate strength values for 4130N tubing from reference 15. This can be justified by noting the relationship between yield strength and fracture toughness of AISI 4000-series steels. Although fracture toughness data on 4130N are sparse in the literature, what does exist is often quoted in terms of K_{Ic}/σ_y, acknowledging the relationship between these two parameters.

In the NASGRO database for 4340, K_{Ic} and ΔK_0 vary inversely with yield strength, with the largest K_{Ic} (135 ksi•in) occurring at a yield strength of 155 ksi. At a yield strength of 175 ksi, the quoted K_{Ic} value drops to 110 ksi$\sqrt{\text{in}}$. A similar relationship exists for 4130, as explained on page 108 of reference 16. At yield strengths from 170 to 179 ksi, K_c for

0.063-in sheet varied from 163 ksi$\sqrt{in}$ to 128 ksi$\sqrt{in}$. Reference 17, table 3.02722 further suggests that for 4130N, K_c is less sensitive to sheet thickness than to yield strength. Also figure 3.02724 indicates an increase in fracture toughness with decreasing carbon content at the same strength level for 4130 series steels. Based on these results and the fact that 4130N tubing received by Fairchild is typically not heat treated to yield strengths above 100 ksi, the use of the modified 160-180 UTS 4340 data for crack growth is conservative. Residual strength of the cracked part is determined by the inserted yield and ultimate strength values for 4130N.

NASGRO crack case TC01, which treats the plate as a rectangular strip with a width equal to the washer circumference, predicts that the flow stress in the pre-SB plate will be exceeded at 6,610 schedules (36,355 hours). There is no growth in the post-SB plate; therefore, the service bulletin appears to have ameliorated cracking as intended. For the weld, NASGRO crack case TC08 predicts no growth before or after the service bulletin. Figure 5-2 shows crack growth curves for the plate before and after the service bulletin.

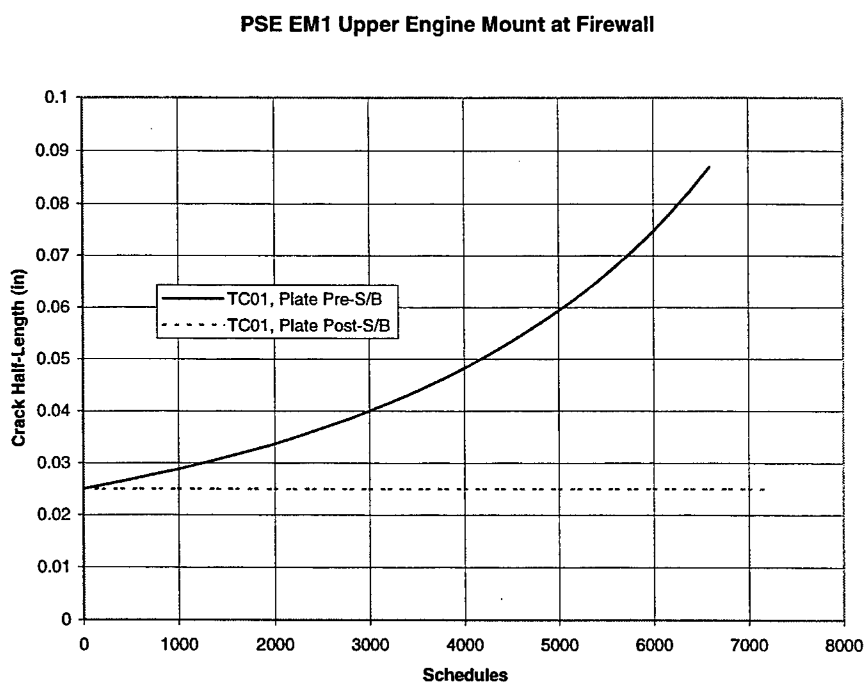


FIGURE 5-2 ENGINE MOUNT BEFORE AND AFTER SERVICE BULLETIN

5.2 PSE N1 SA226 AND SA227 NACELLE UPPER LONGERON AT THE FIREWALL

Each engine mount bolt passes through the firewall and attaches to a steel fitting. The load in the fitting is then transferred to an 0.090-in-thick longeron (cap) via six bolts loaded in shear. These bolts also pass through the 0.032-in-thick aluminum keelson web, which is riveted to the cap. For the purposes of this analysis the beneficial effects

of the firewall and web in reducing the cap load are conservatively ignored. Bending effects due to the dog leg of the cap are also neglected.

To find the load transferred to the cap by the shear bolt farthest aft, a simple stiffness model was constructed in Excel considering the fitting and cap as axially loaded flat strips. (In reality, the cap is an angle while the fitting is a tapered channel.) Both strips are modeled with a width of 1.12 inches but the fitting area is increased to account for the additional area of the channel section. In effect the fitting has twice the area of the cap in addition to having a modulus three times as high. The 0.156-in diameter bolts are spaced every 0.75 inch. With this geometry, the model shows that about 48% of the load applied to the fitting is transferred to the cap by the aft bolt.

The load applied to the fitting by the engine mount truss was determined as it was for PSE EM1. As was done there, the entire upper truss load is assumed to be carried by one fitting.

NASGRO crack case TC03 was selected to analyze the growth of a crack away from the aft bolt hole and upwards in the cap. NASGRO does not have material constants for 2024-T42, so constants for 2024-T3511 were used in lieu of these. A 0.050-inch through crack in the cap grew at a relatively slow rate until the flow stress was exceeded at 29,057 schedules (159,814 hours) as shown in Figure 5-3. At that time the crack length was 0.91 inch.

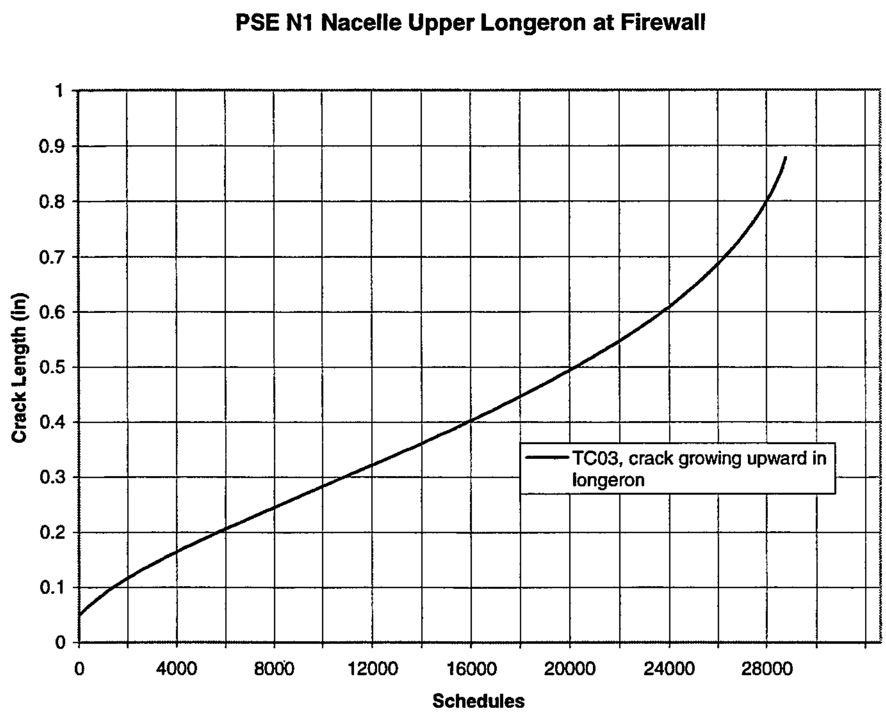


FIGURE 5-3 PSE N1 NACELLE UPPER LONGERON AT FIREWALL

5.3 PSE N2 SA226 AND SA227 NACELLE UPPER LONGERON AT WING RIB ATTACH ANGLE

The aft end of the longeron is sandwiched between two wing rib attach angles and fastened with five steel fasteners. A free body diagram of the longeron (Figure 5-4) neglecting the keelson web reveals that bearing loads in the fasteners are amplified due to the eccentricity of the applied load.

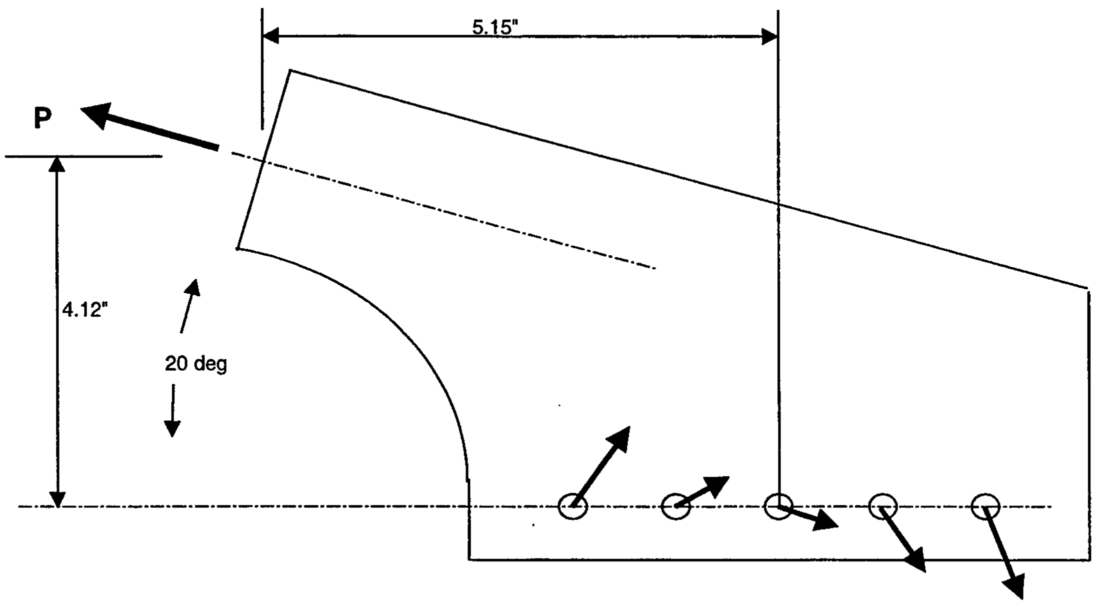


FIGURE 5-4 FREE BODY DIAGRAM OF LONGERON SECTION (KEELSON WEB NEGLECTED)

The stress in the longeron about 3 inches forward of this location was measured by gage 28 during Phase I. To more accurately estimate the load distribution in the five fasteners, a finite element model was built in NASTRAN and is pictured in Figure 5-5. The model includes one of the two attach angles, the portion of the longeron aft of the strain gage, and a portion of the lower keelson web which is attached at the top to the longeron and at the bottom by the relatively stiff drag brace fitting. A unit load is applied to the longeron cross section in the direction of the engine mount at the front of the nacelle.

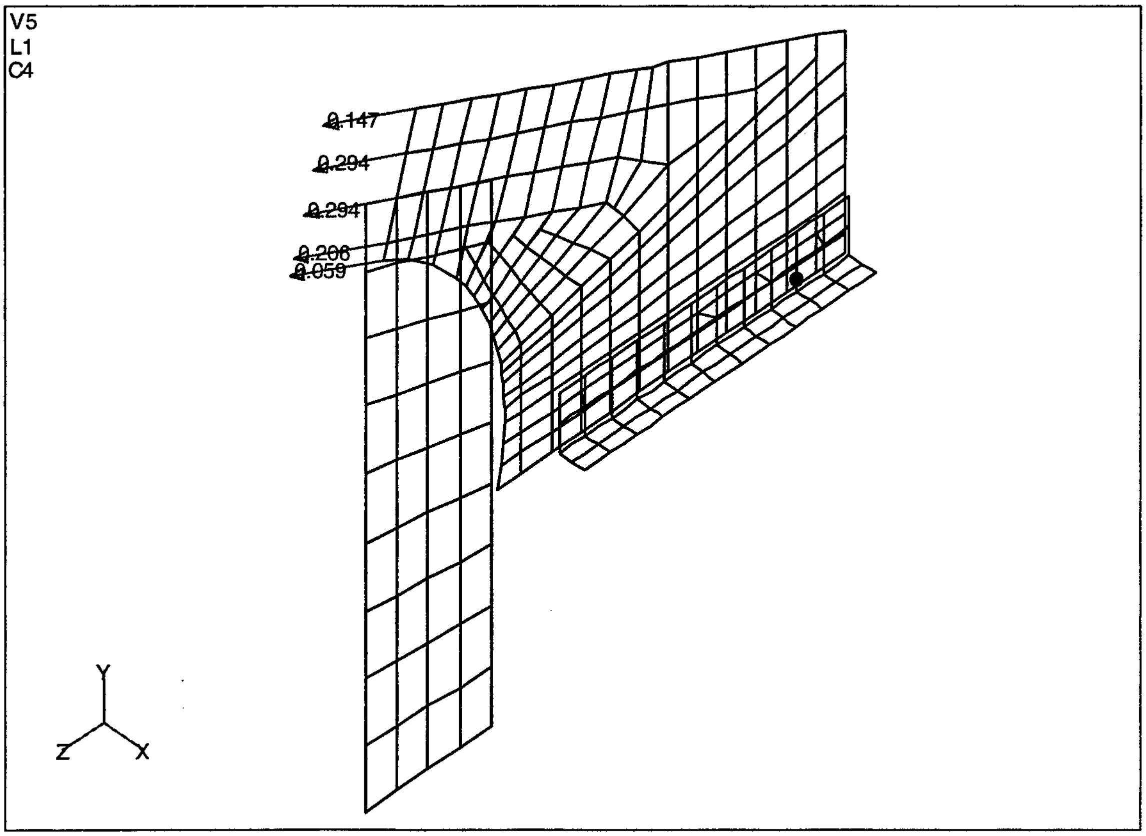


FIGURE 5-5 NASTRAN MODEL OF LONGERON ATTACHMENT TO WING

The NASTRAN model predicted that the highest fastener load occurs in the forward fastener. This is due in part to the fact that the forward portion of the attach angle is prevented from rotating downward by the two 0.125-in chordwise straps. This increases the effective bending stiffness of the attach angle at this location and results in higher fastener loads than would occur if the angle were free to flex downward. The NASTRAN model predicts that the load in the forward fastener is 81% of the applied load in the longeron. This fastener load will tend to cause compression, however, as it is directed away from the end of the part. Fastener loads which will cause tension—those in the aft fastener holes—are significantly lower.

The growth of a 0.05-in through crack at the first fastener hole was analyzed using NASGRO crack case TC05 with the conservative assumption that each of the five fastener holes carries 81% of the applied load. The model predicts insignificant growth (only 0.0015 inch) at over 100,000 hours.

5.4 PSE N3 SA226 AND SA227 NACELLE UPPER LONGERON WING RIB ATTACH ANGLE

Upward bending of the aft portion of the wing rib attach angle results from the tendency of the longeron to rotate in response to the upper engine mount loads. The keelson web structure riveted to the longeron inhibits this rotation and thereby decreases the

stress in the angle. The NASTRAN model (Figure 5-5) accounts for the lower keelson web but not for the upper web, which provides additional stiffness to the wing skin through the nacelle skin. A schematic of this arrangement is shown in Figure 5-6. It is clear that upper engine mount loads have an alternate path through the keelson web should the wing rib attach angles fail.

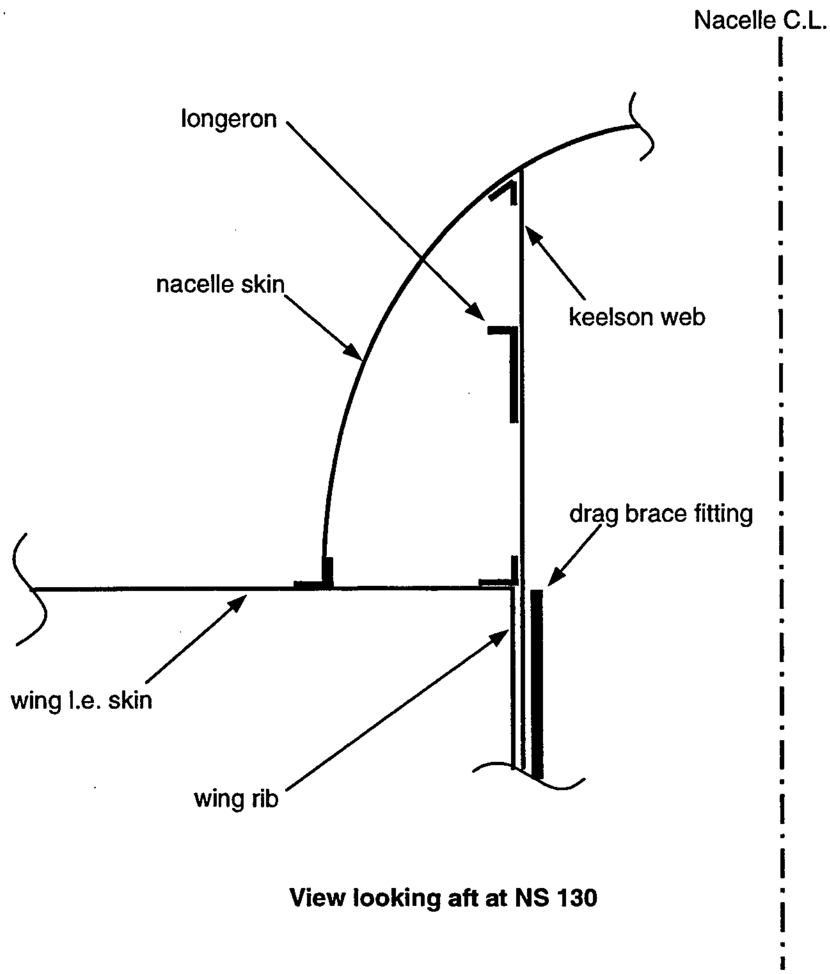


FIGURE 5-6 SCHEMATIC OF UPPER NACELLE STRUCTURE

The NASTRAN finite element analysis assumes that the horizontal leg of the attach angle is clamped along the edges of the seven fasteners which secure it to the wing. The vertical leg is constrained from moving inboard or outboard. With these assumptions, a unit tension load in the longeron produces a bending stress of 75 psi in each angle on the bottom of the horizontal leg at the aft fastener. During a 5 fps landing impact, gage 28 showed a peak stress of 3340 psi in the longeron. Since the longeron has a cross sectional area of 0.217 in^2, the applied load is 725 lbs and a stress of 54 ksi is developed in the angle. This exceeds the yield strength of 2024-T4. It is quite possible that on the first extremely hard landing the angle experiences local yielding on the bottom surface near the last fastener hole. No problems with this part have been noted in service, however.

In the absence of the keelson web or nacelle skin structure, it appears that the upper attach angles would not have sufficient bending stiffness to arrest powerplant motion in the event of an extremely hard landing. However, for the upper mount loads to fully transfer to the angles, the entire length of the keelson web would have to be failed. Even if this unlikely scenario were to occur, the lower nacelle structure would assume more load, transferring it to the lower wing and away from the attach angles on the upper wing.

The progress of a 0.05-in through crack at the critical location in the angle was analyzed using NASGRO crack case TC02. The crack was assumed to grow forward along the horizontal leg of the attach angle, which is 5.25 inches long. Yielding occurred at the first schedule, but growth proceeded thereafter until the flow stress was exceeded at 23,630 schedules (129,970 hrs). At this point the crack length was 0.49 inch. This behavior is shown in Figure 5-7.

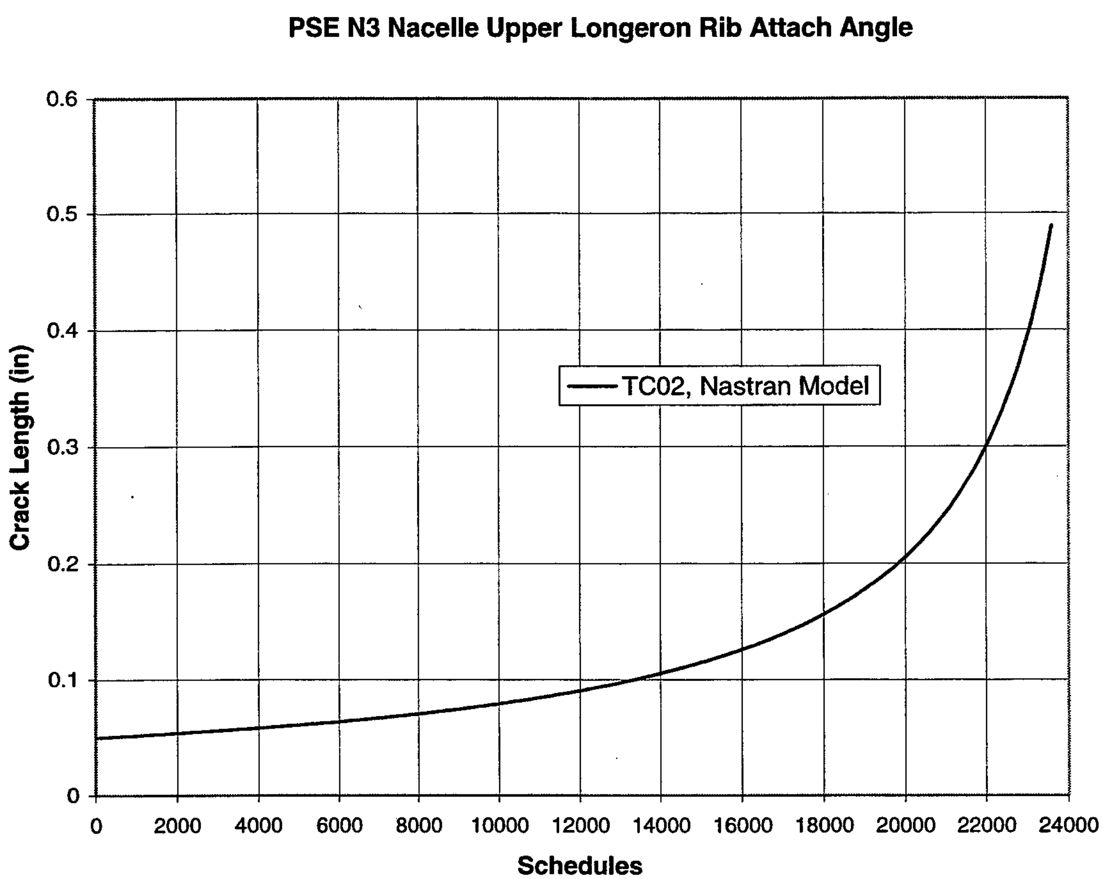


FIGURE 5-7 PSE N3 NACELLE UPPER LONGERON ATTACH ANGLE

6. HORIZONTAL AND VERTICAL STABILIZER GROUP

6.1 PSE H1 SA226 AND SA227 HORIZONTAL STABILIZER RIB STRAP AT REAR SPAR BL 3.135

Transverse cracks in the rib strap, where the strap meets the rear spar, have been observed in service. Subsequently, this design detail was changed. The splice plate external to the skin was extended further outboard and forward to cover the area of the strap prone to cracking. In addition, the rib strap itself was widened and another 0.125-in strap beneath the spar was extended across butt line 0.0 instead of ending there. The spar ends at station 0.0 as before.

For this analysis, the rear spar splice at BL 0.0 is considered to have no bending stiffness about the lateral axis, perpendicular to BL 0.0. Therefore the rip strap must carry the whole component of stabilizer bending moment generated by the 20° rear spar sweep angle. Conversely, the rib strap is assumed to have no bending stiffness about BL 3.135, so the spar splice must carry this entire component.

The gross stress in the rib strap was estimated as follows based on the above assumptions. The stress analysis is provided in Appendix A. Measurements of actual stress in the spar were available near station 15 (page 14 of reference 1). This stress was translated into a moment at BL 15 using the section modulus. Next the moment was extrapolated inboard along the spar to just outboard of BL 3.135. This was done assuming a quadratic moment curve ranging from 0 at the stabilizer tip to a maximum at BL 3.135. The moment in the rib strap just forward of the spar could then be calculated as sin (200) times the spar moment. Finally, the stress in the rib strap just forward of the end of the splice plate was found using the section modulus at this location. The stress in the rib strap was calculated to be about twice the measured stress in the spar at BL 15. For example, during a 2-g pushover the measured stress in the spar was 1554 psi while the calculated stress in the strap was 3039 psi.

To find the load carried by the first fastener in the splice plate, a finite element model was constructed in Excel. For the idealization, the strap was modeled as 1.0 inch wide, while the first plate element was 0.75 inch wide and the second was 1.5 inches. The model predicted that the first fastener carries 25% of the applied load in the strap. With these results, NASGRO model TC03 predicted no appreciable crack growth beyond 0.05 inch after 21,000 schedules (115,500 hours). This was based on load spectra for taxi, flight, and prop wash. The prop wash spectrum accounts for 2 minutes per flight of stress cycling at 5.2 Hz, the torsional natural frequency of the tail section. Stresses were measured at several locations for 110% torque run-up on the ground during Phase I [1]. Stresses at lesser torque values are neglected in the spectrum since the 110% torque stresses are already quite low.

Although the crack growth analysis predicts a long life, the existing inspection in the Airframe Airworthiness Limitations Manual requires repetitive inspections. These inspections consist of penetrant or eddy-current checks of the inboard edges of the

upper and lower straps beginning at 30,000 hours and continuing every 2000 hours thereafter. Inspections are not required for the commuter category aircraft (SA227-CC and -BC) because these models were built with the strengthened configuration described above. The SID will require accomplishment of a new service bulletin to update of all affected aircraft to the strengthened configuration.

6.2 PSE H2 SA226 AND SA227 HORIZONTAL STABILIZER PITCH TRIM ACTUATOR FITTING

The strain survey of the test aircraft during Phase I found the following:

- A 201 lb static load on the horizontal stabilizer above the fitting produced 828 psi at gage 10 (reference 1, Sec 5-4).
- 1 g flight produced 1200 psi at gage 10 (reference 1, Table D-7)
- Stress per g during flight was 1225 psi at gage 10 (reference 1, Table D-7)

From the above measurements it can be inferred that the 1-g load and the load per g on the fitting is about 300 lbs. Since there are four lugs, ideally each lug would carry 75 lbs. However, for the NASGRO analysis it is assumed that each lug carries half the load, so that the load is 150 lbs per lug.

The bending stress at the root of the lug, with the load applied approximately transversely, is $12PLR/[t(2R)^3]$ where P is the load, L is the distance from the lug root to the hole center, R is the lug radius, and t is the lug thickness. Substituting a load of 150 lbs, a radius of 0.56 inch, L of 0.75 inch, and thickness of 0.27 inch in the equation yields a bending stress of about 2,000 psi.

NASGRO crack case TC02 was used to analyze the growth of a 0.05″ through crack originating at the root of the lug. The actual lug material is 2024-T4, but since this is not available in NASGRO, the properties for 2024-T351 plate T-L were used instead. Data in MIL-HDBK-5G show that 2024-T351 has similar properties to 2024-T4. Plate T-L form is the worst-case for crack growth.

As expected, the low stress level produced no appreciable crack growth. Even after 21,000 schedules (115,500 hours), the crack had not propagated 0.001 inch.

6.3 PSE V1 SA226 AND SA227 VERTICAL FIN MAIN SPAR CAP STRIPS BELOW PIVOT FITTING

A schematic of PSE V1 is shown in Figure 6-1. A number of stiffening straps end in the vicinity of the pivot fitting, which consists of a 0.190-in channel and 0.190-in angle spliced together. The stresses caused by load transfer between the various members were analyzed using a finite element model built in Excel. There, the straps are considered as axially loaded bars connected by shear springs (fasteners). The spar

webs and the webs of the channel and angle were not included. Although the real PSE has two staggered rows of fasteners, such that there is a fastener every 0.40 inch, the model has a single row of lumped fasteners whose stiffness and spacing have been doubled. Such a simplification greatly reduces the degrees of freedom and complexity of the finite element model.

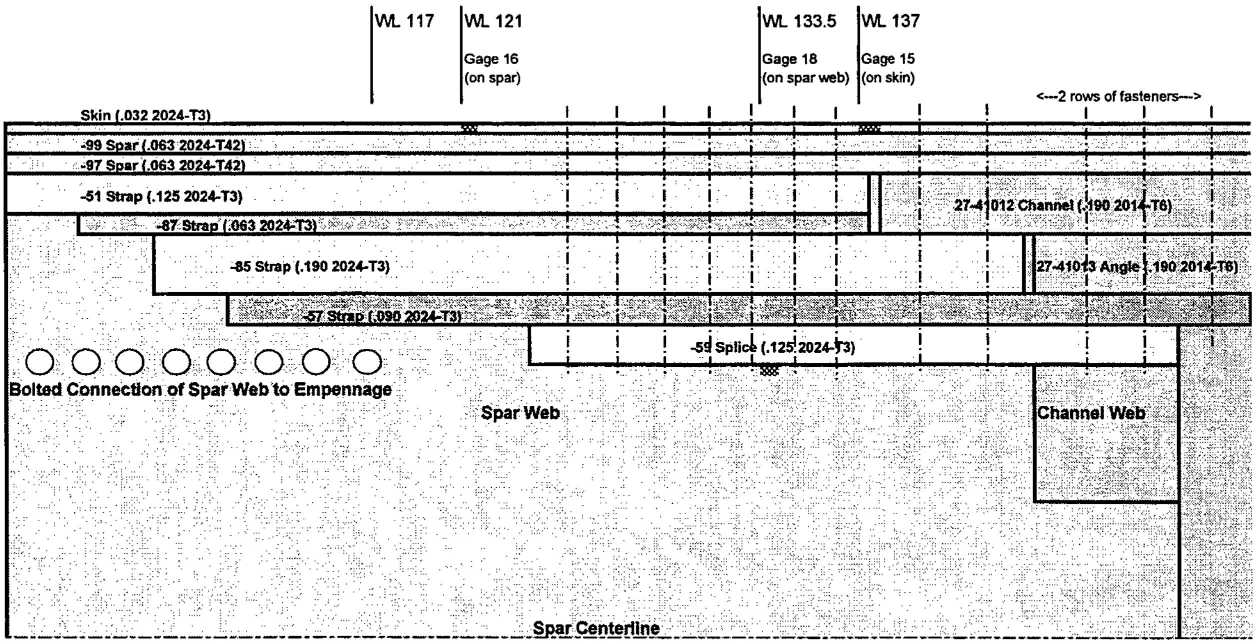


FIGURE 6-1 SCHEMATIC OF VERTICAL TAIL PIVOT FITTING SPLICE

As predicted by the model, the highest total stress (gross + bearing) occurs at the first fastener of the 0.090-in strap. All of the straps are made from 2024-T3. Since 2014-T6 has less crack toughness, the worst case in the pivot fitting was also considered. The highest stress in the 2014-T6 fitting occurs in the last fastener of the channel. Both of these cases were analyzed using the NASGRO model TC03.

Stresses in service were obtained from measurements at gage 15 [1], which was located on the skin just below the last fastener in the fitting. The 1-g stress was about zero while the stress per g was about 1200 psi. In addition, the maximum stress due to prop wash at 110% torque was found to be about 1200 psi. The finite element model stresses were then scaled to match these measured stresses.

In the NASGRO model, a prop wash load spectrum was added to the existing flight and taxi spectra. The prop wash spectrum consists of 624 cycles per flight, with the stress varying from –2200 to 1200 psi. At 2 minutes of operation at 110% torque, the tail vibration frequency of 5.2 Hz results in 624 cycles. The NASGRO analysis predicts that 0.05-inch through cracks in the strap and the fitting do not grow under fatigue spectrum loading.

7. CARGO DOOR SURROUND STRUCTURE GROUP

7.1 PSE F4 SA226 AND SA227 FUSELAGE FRAMES AT FWD AND AFT CARGO DOOR LATCHES

PSE F4 is located under the floorboards where a lightening hole, tooling hole, bend relief, and stringer cutout are in close proximity to the lower door latch receptacle. These features result in high stress-intensity factor for any crack forming in this area and subsequent rapid crack growth.

Beginning with SN 470, the tooling hole was moved away and the lightening hole was eliminated. In addition, a stiffening channel was installed across the region prone to cracking. These modifications were present on the aircraft used for the Phase I strain survey [1]. Stresses recorded there were compressive at the area just above the stringer cutout. For prior designs, service bulletins 226-53-007 and 227-53-003 provide a remedy by installing a doubler over the affected area. The bulletin has proven effective at preventing further cracks in this area.

7.2 PSE F5 SA226 AND SA227 FUSELAGE FRAME AT CARGO DOOR LATCH AT FS 455.7 AND 473.4

The fuselage frames at the cargo door lower latches are subject to Service Bulletins 226-53-007 and 227-53-003. These bulletins among other changes add doublers to the frames or if cracks are found replace the frames with a new thicker frame, 27-22207. These new frames are factory installed on aircraft SN 457, 470, 479, and up.

This area was strain gauged and the stresses due to pressurization calculated (Appendix D of reference 1). The maximum stress at 7.0-psi cabin pressure was measured at 9730 psi close to the stringer cutout below the latch fitting.

The calculation of the crack growth rate for this location assumes the aircraft is pressurized to the maximum cabin pressure for each flight. The initial flaw can be represented by a 0.05-in through crack at the edge of the stringer cutout. The crack growth rate becomes unstable after 330,000 cycles as depicted in Figure 7-1. The critical crack length is 1.0 inch. Without the reinforcements implemented by service bulletin this structural detail has short life and is unacceptable. Several aircraft in service have displayed cracks at this location after about 20,000 hours. The inspection intervals will reflect the short life, if the service bulletin is not made mandatory.

PSE F5

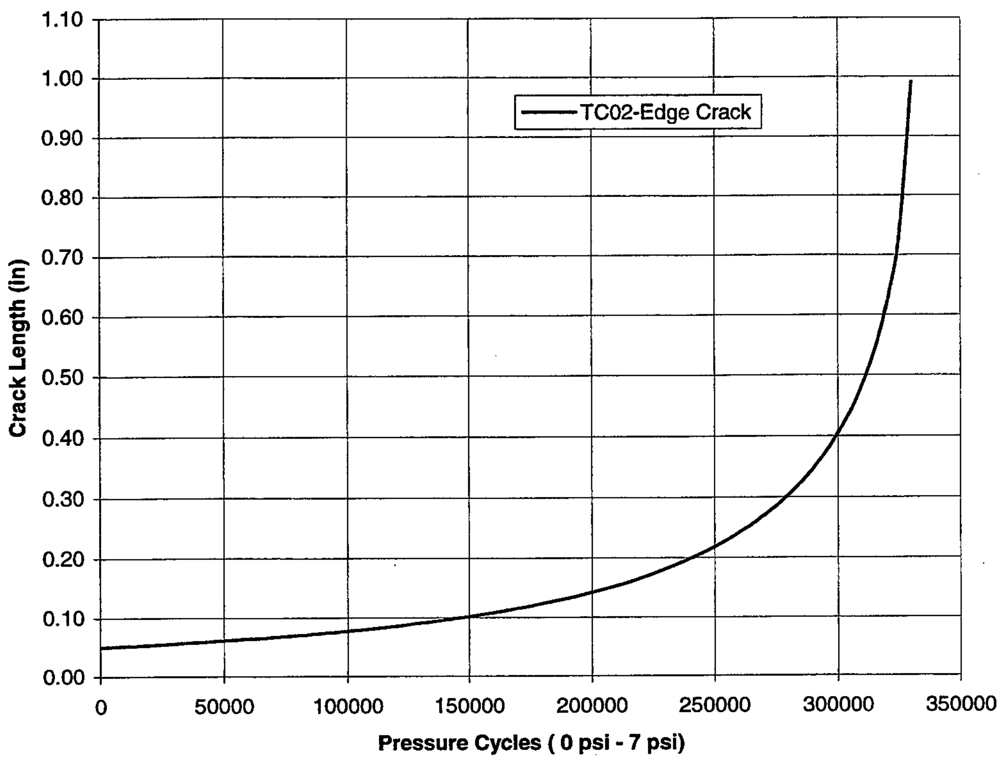


FIGURE 7-1 PSE F5 LOWER LATCH FRAME AT STRINGER CUTOUT

7.3 PSE F6 SA226 AND SA227 FUSELAGE FRAME AT CARGO DOOR SIDES

The fuselage frames at the sides of the cargo door are loaded in bending due to the redistribution of pressurization loads around the cargo door opening. The configuration for this detail is shown on page 6-43 of reference 1. The bending stresses are exacerbated by the stress concentration caused by a notch at a bend relief in the frame, which disrupts the inner flange. The combination of the notch and a nearby lightning hole causes a short crack growth life at this detail.

Because of reported problems with this detail an Airworthiness Directive (AD) has been issued mandating service bulletins 226-53-007 and 227-53-003 to reconfigure the structure. The new structure is the same as the production configuration on latter aircraft. The aircraft used for the strain survey also had the updated design. Measured stresses on this aircraft, at the location of previous cracking, are shown in Table D-1 of reference 1. One can see that the stresses after the structural modification are in compression.

7.4 PSE F7 SA226 AND SA227 CARGO DOOR HINGE

This is a standard hinge, part number MS20001P-8, made from anodized 2024-T3511 extrusion that is nominally 0.063 inch thick. To find the stress in an individual hinge tab, strain gage readings are available on the 0.032-in cargo door skin, about 4 inches below the hinge. The maximum stress recorded after full pressurization to 7 psi was 7.7 ksi at gage 6 [1]. The hinge itself is twice as thick as the skin but interleafing reduces its effective width by half so that its load carrying area is about the same as the skin's. In addition the 0.030-inch radius at the root of each tab causes a significant stress concentration. The stress concentration factor has been estimated at 3.0 using formulas given in reference 8 and the calculation in Appendix A. The resulting stress at the root of the tab is estimated to be 23 ksi at full pressurization. This simple analysis agrees well with a NASTRAN finite element analysis (FEA) model of a portion of the hinge. The FEA model, which is shown in Figure 7-2, also predicts a stress of about 23 ksi at the root of the first hinge tab.

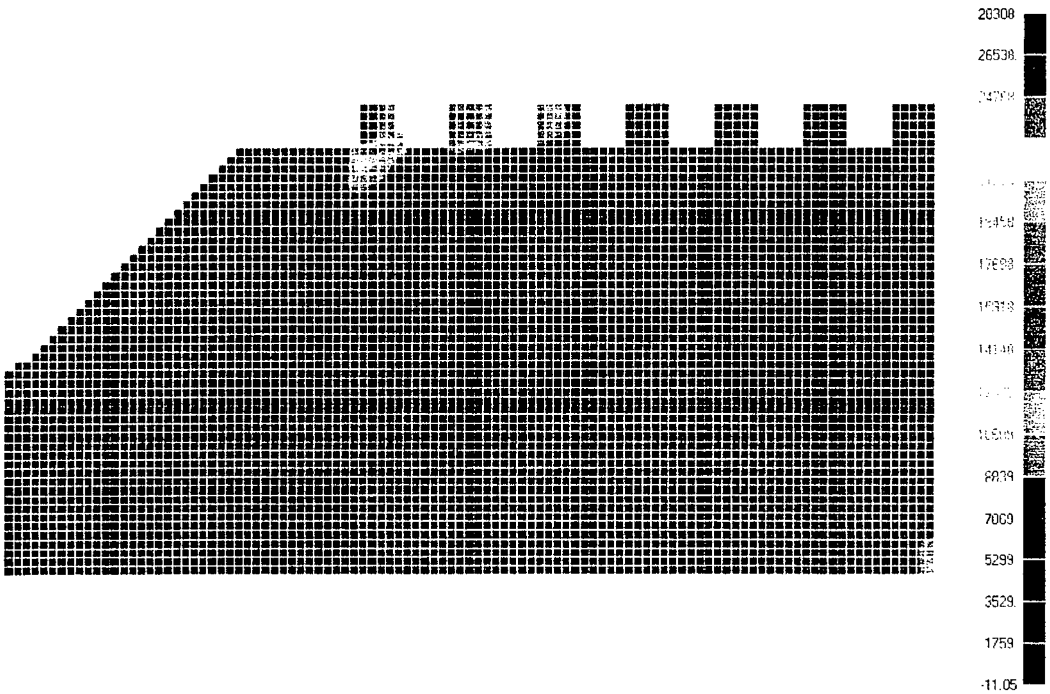


FIGURE 7-2 CARGO DOOR HINGE FINITE ELEMENT MODEL

Since failure of one tab does not constitute failure of the hinge, primary growth in one tab as well as secondary growth in the remaining tabs have been analyzed. The worst case occurs when the outermost tab contains the rogue flaw and fails first. Since there are 36 tabs, the P/A stress in the remaining tabs will increase by a factor of 36/35 = 1.03. In addition, the eccentricity of the pressure load resultant to the remaining tabs will create a moment, which increases the tension stress in the tabs. However, for the first tab failure the additional stress due to this moment is less than 1% of the P/A stress because the eccentricity is small.

NASGRO crack case CC01 can be used to predict how a corner crack at the root of a hinge tab will propagate when subjected to stress cycles of 0-23 ksi. NASGRO case TC02 can be used to analyze continuing damage in remaining tabs subjected to 0-24 ksi stress cycles. It should be noted that this analysis is quite conservative, as not every flight will actually reach the full 7-psi pressurization altitude.

Figure 7-3 shows the predicted growth rate for a 0.05- x 0.05-inch rogue flaw at the root of a tab as well as secondary growth of initial 0.005 through flaws in adjacent tabs. The second curve represents onset of WFD in the hinge and determines its replacement life.

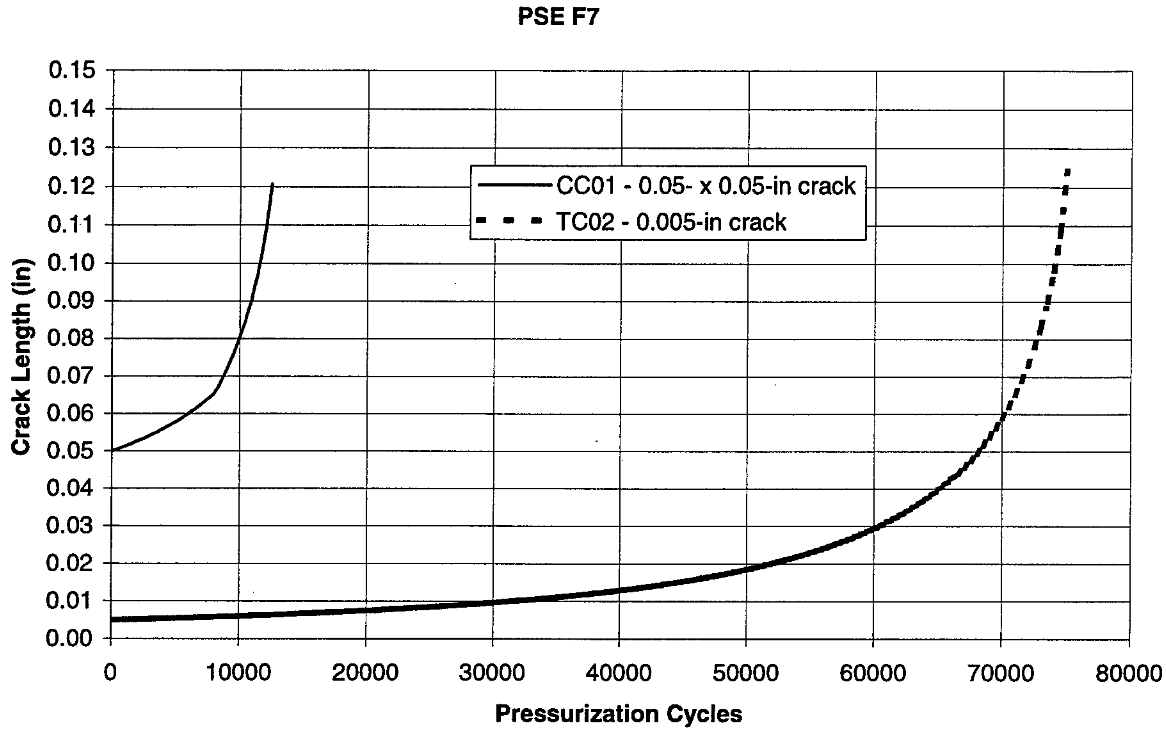


FIGURE 7-3 PSE F7 CARGO DOOR HINGE

The primary flaw grows to a critical size of 0.125 inch after 13,200 cycles. Routine visual inspections have proven adequate to detect failure of one hinge tab. Secondary cracks become critical at about 75,000 cycles, at which time they are also 0.125 inch long. Eddy-current inspections should be able to detect these cracks 1,000 cycles earlier when they are 0.10 inch long. Therefore, eddy-current inspection of the hinge should begin at 37,500 hours and be repeated every 1,000 cycles. The Airframe Airworthiness Limitations Manual currently specifies a 15,000-hour threshold and 2,000-hour repeat inspection of the cargo door skin around the hinge fasteners. Rather than increase the frequency of inspection to 1,000 cycles, it will probably prove more cost-effective to simply replace the hinge at 37,500 hours.

It should be noted that no hinge failures occurred after application of 150,000 cycles at 7 psi during the fatigue test. Therefore the scatter factor of 1 is warranted for the repeat inspection interval above.

7.5 PSE F10 SA226 AND SA227 CARGO DOOR OPENING CORNERS

PSE F10 is subjected to the fatiguing effects of pressurization. During the SA226 fatigue test several cracks ranging from 0.1 to 3.1 inches long were found emanating from the corner of the door cutout after 74,753 hours had elapsed.

The stress at location F10 was measured during the Phase I strain survey and reported in Table D-3 of reference 1. The highest stress measured in the region was 7.7 ksi. The crack growth analysis for this location was performed assuming a 0.05-in edge crack in the 0.040-in sheet. The resulting life is almost 300,000 cycles with full pressure differential. At this time the crack has grown to 0.26 inch. This is more than an adequate crack growth life. The crack growth prediction is shown in Figure 7-4.

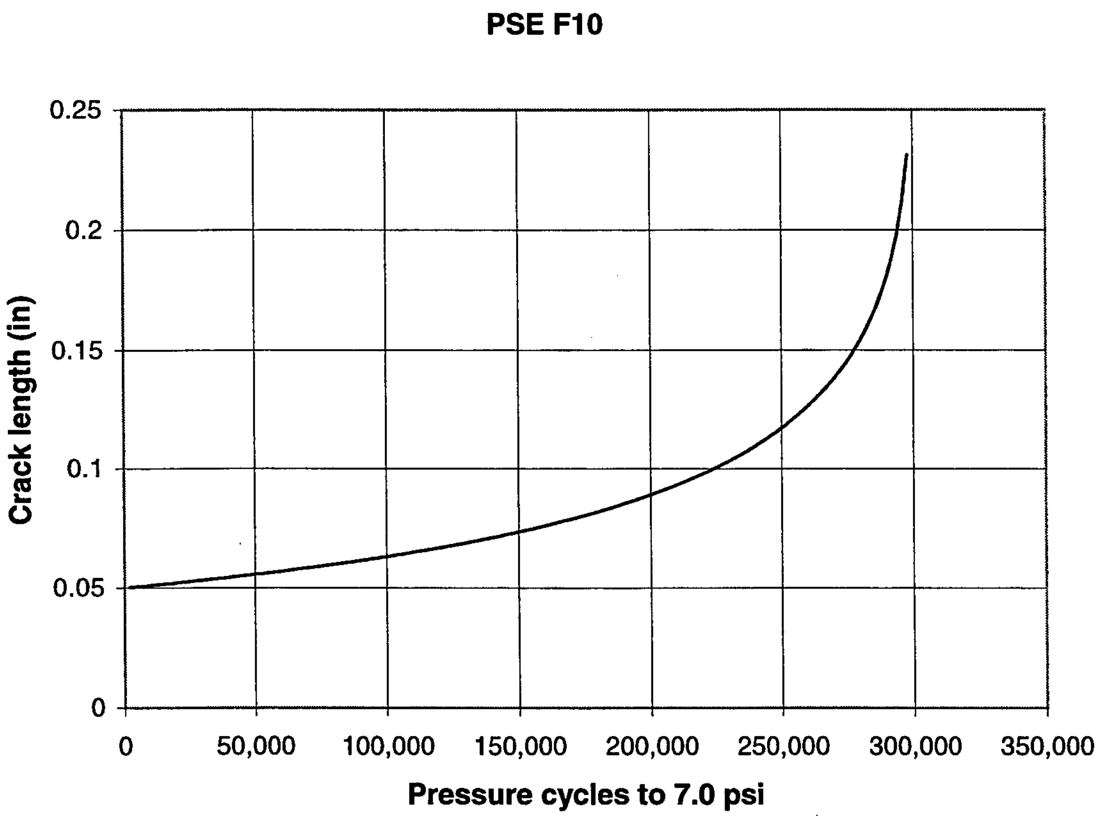


FIGURE 7-4 PSE F10 CARGO DOOR CUTOUT CRACK GROWTH

8. OTHER FUSELAGE GROUP

8.1 PSE F1 SA226 AND SA227 T-STRINGER AT TOP CENTERLINE NEAR FS 330

The main fuselage is assembled from quarter sections. Butt splices at T-stringers join the sections. The loads are highest at the top of the fuselage where the stress due to pressurization is augmented by the stress due to fuselage bending.

The stress analysis assumes a maximum Pr/t hoop stress of 5775 psi. As explained in reference 1, this stress level is conservative. It is applied to the 0.040-in skin and is considered to result in evenly distributed bearing loads along each row of rivets at the stringer. With a separation of 0.75 inch between the #4 fasteners, the bearing load at each rivet is ideally 173 lbs. The stress in the longitudinal (axial) direction was measured by gage 9 during Phase I and found to be about 3550 psi at 1 g and 1300 psi per additional g. The measured axial stress is slightly higher than calculated by Pr/2t due to fuselage bending as explained in reference 1.

Early aircraft had T-stringers made from 2014-T6 extrusions. In latter aircraft the stringer material was changed to 7075-T73 and the stringer thickness was increased from 0.050 inch to 0.063 inch. Crack growth analysis has been performed on both configurations. NASGRO crack case TC05 considers a through crack growing from a rivet hole in the T-stringer toward an adjacent rivet hole and in the 2024-T3 sheet attached at the T-stringer. This model includes the effects of the bi-axial stress state resulting from circumferential and longitudinal loads. The crack growth curves for the three cases are shown in Figure 8-1. As the graph demonstrates, growth rate is slow and there is only insubstantial crack growth in the economic life of the aircraft.

Note that this is the only fuselage PSE where inertia and pressurization loads are considered together. Therefore the pressurization load block in the NASGRO input file had to be applied five times per schedule rather than only once per schedule as for other fuselage PSE's. This is because the NASGRO load schedule consists of five flights (cycles) when inertia loads are considered and only one flight when only pressurization loads are considered.

PSE F1

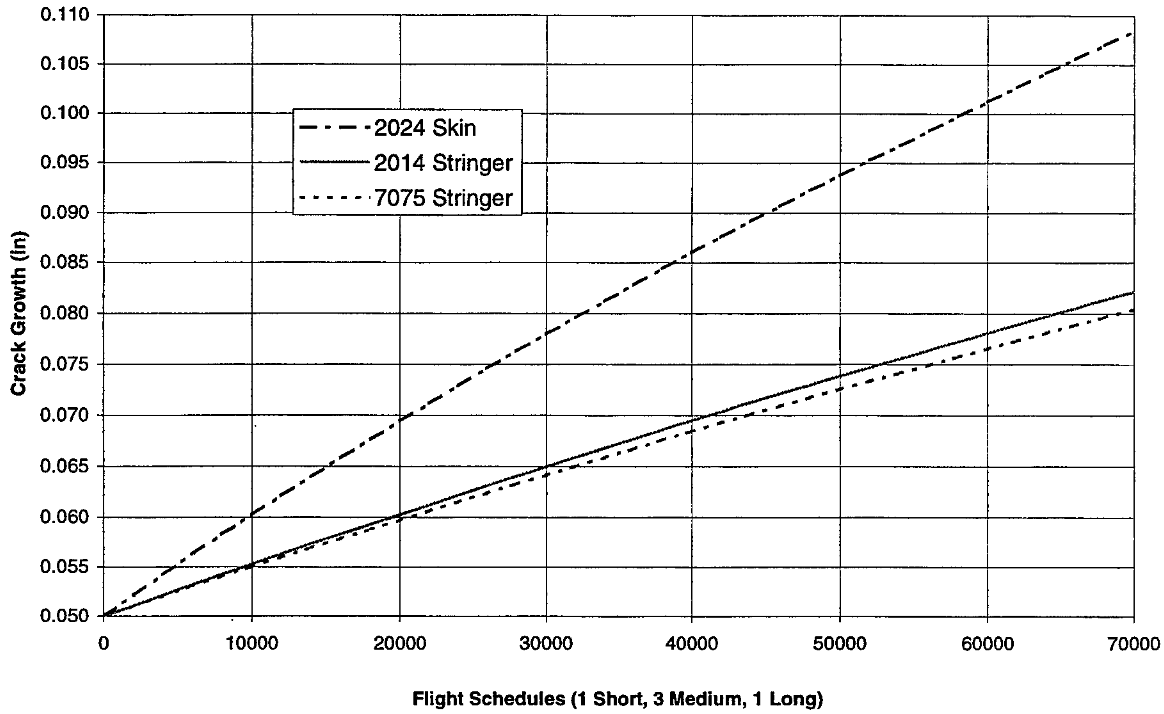


FIGURE 8-1 PSE F1 T-STRINGER, TOP CENTERLINE NEAR FS 300

8.2 PSE F2 SA226 AND SA227 WING TO FUSELAGE FORWARD ATTACHMENT FITTING

This fitting is made from two forged pieces and provides one of the attachments of the wing to the fuselage. There is also, in addition to the front spar attachments, a series of fasteners loaded in shear connecting the wing spar webs to the fuselage frames. The forged fittings are loaded primarily in compression, since they are located at the upper wing inboard of the gear. Therefore no crack growth analysis was performed.

8.3 PSE F3 SA226 AND SA227 WING TO FUSELAGE AFT ATTACHMENT FITTING

This fitting is made from two forged pieces and provides one of the attachments of the wing to the fuselage. There is also, in addition to the rear spar attachments, a series of fasteners loaded in shear connecting the wing spar webs to the fuselage frames. The forged fittings are loaded primarily in compression, since they are located at the upper wing inboard of the gear. Therefore no crack growth analysis was performed.

8.4 PSE F8 SA226 AND SA227 CORNERS OF PASSENGER WINDOW CUTOUTS

This item was subjected to extensive testing as part of the SA226 fatigue test. At the time the test was run the majority of the window corners developed cracks in the

aluminum surround structure at times equivalent to 72,000 and 90,000 hours [5]. These cracks were allowed to grow without repair for an additional 20,000 hours. The cracks showed a stable growth pattern with decreasing growth rate as they propagated out of the high stress field at the window corners. The cracks were first detected when their length was between 0.4 and 1.2 inches. Figure 8-2 shows the growth history of a few representative cracks which were discovered growing from fastener holes at the corner of window cutouts. As these are naturally occurring cracks that may be detected by simple visual inspections, this data will be used to determine the initial and recurrent inspection intervals for PSE F8.

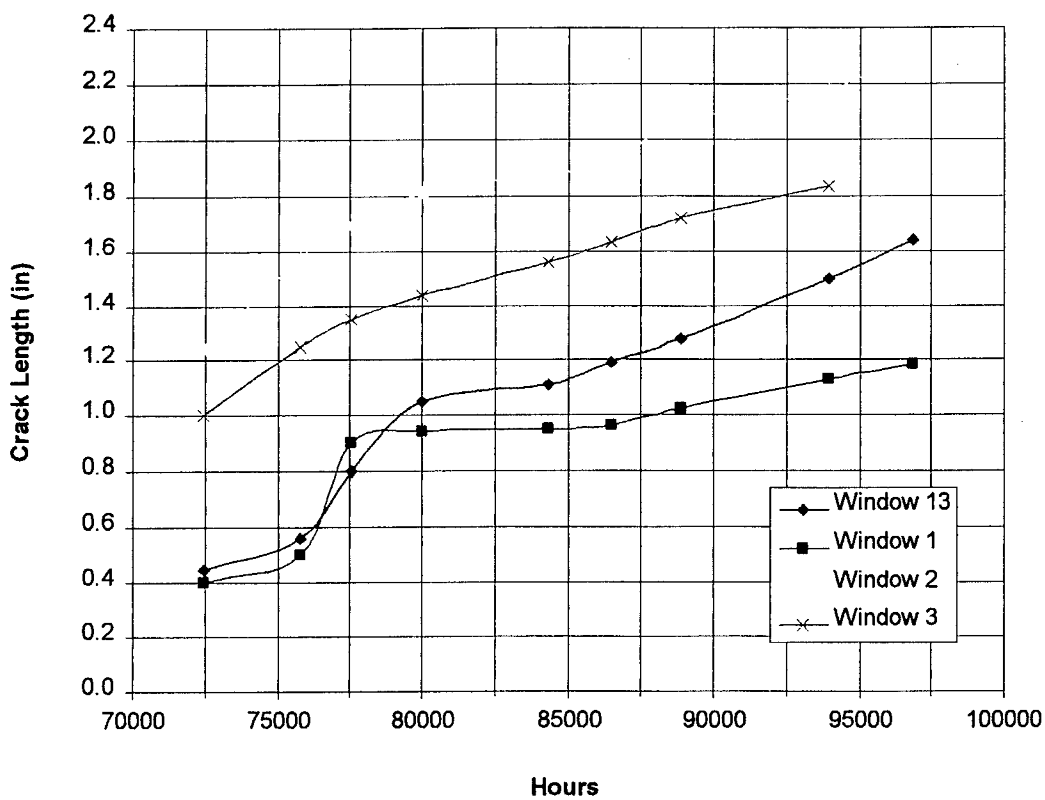


FIGURE 8-2 FATIGUE TEST DATA – CORNERS OF WINDOW CUTOUTS

8.5 PSE F9 SA226 T-STRINGER, BOTTOM CENTERLINE AFT OF FS 362

The configuration of this PSE F9, at the bottom of the fuselage, is identical to that of PSE F1 at the top. The stresses however are less severe because the bending stress due to in-flight gust loading is of opposite sign. The results from F1 can therefore be used as minimum results for F9.

8.6 PSE F11 SA226 AND SA227 FORWARD PRESSURE BULKHEAD

The bulkhead is stiffened on its forward side by several vertical channels. The longest of these is 27-21063-2; a hat channel 1.0 inch wide and 0.063 inch thick and made from

clad 2024-T3 extrusion. Gage 1 [1] was mounted on the portion of the channel with the highest bending stress due to cabin pressure. At 7.0-psi internal pressure, the stress was 7.7 ksi, while during flight at 0 psi internal pressure the stress ranged from 0.25 ksi to 0.6 ksi.

NASGRO case TC01 was used to analyze the life of this channel with a 0.050-in edge crack. The cracked portion was modeled as a 1.0-inch-wide strip subjected to a cyclic stress of 0 to 8.3 ksi. Figure 8-3 shows that the flow stress of the channel is exceeded only after 372,000 cycles, at which time the crack grown becomes unstable.

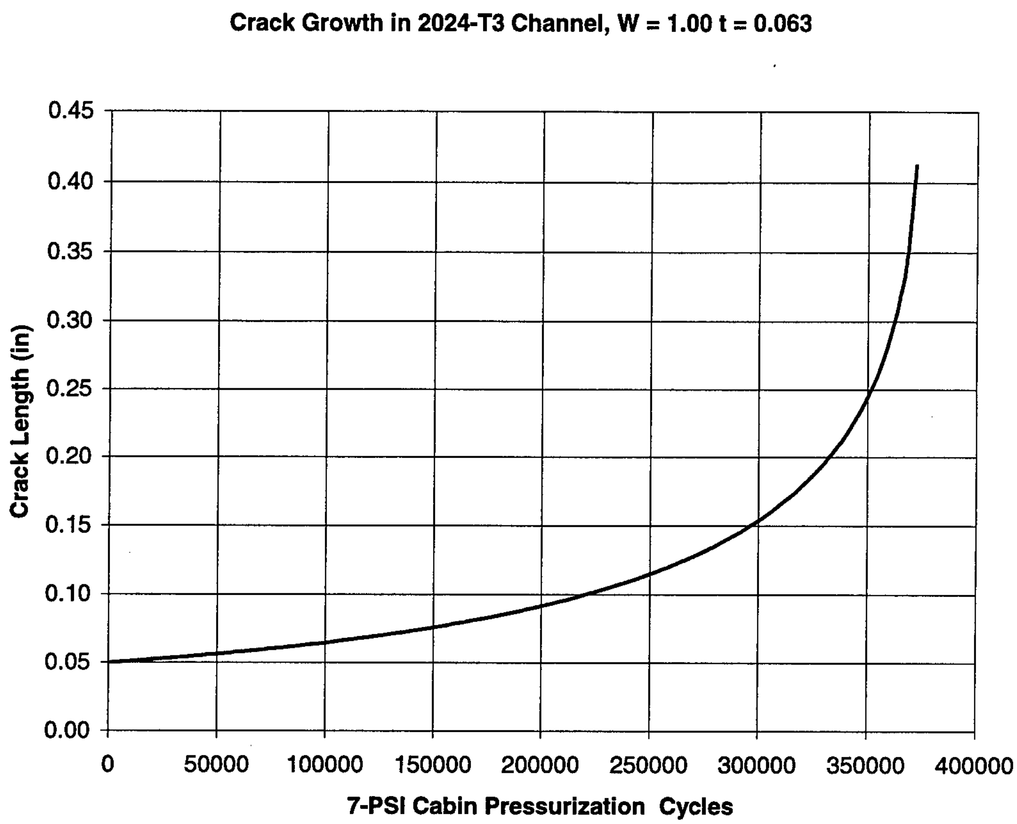


FIGURE 8-3 PSE F11 FORWARD PRESSURE BULKHEAD CHANNEL

8.7 PSE F12 SA226 AND SA227 PASSENGER DOOR OPENING CORNERS

Cracks were discovered at location PSE F12 after 51,700 hours had elapsed in the SA226 fatigue test [5]. One crack that emanated from the corner of the door cutout had a length of 1.2 inches when discovered. These observations as well as the absence of in-service cracks will be used with an appropriate scatter factor to establish an inspection threshold and repeat inspection interval for the passenger door opening.

8.8 PSE F13 SA226 AND SA227 CONTROL COLUMN ROLLER BEARING

The control column of these aircraft is supported by a roller bearing at each end which is attached to the cockpit sidewall by a 0.25-inch diameter stud. The load on the 4118 steel stud is only a small fraction of its shear strength, but if the nut is not tight, the stud is subjected to bending stresses and rapid fatigue failure. After several failures of this stud in the field, Service Bulletins 226-27-060 and 227-27-041 and AD 97-02-02 were released to check stud tension via the nut torque. However, the stud can be inspected for cracks only by completely removing it. Hence an alternate design has been developed that does not rely on bolt tension to eliminate bending stresses. This design was implemented by Service Bulletins 226-27-061 and 227-27-042. These service bulletins will be made mandatory via the SID.

The function of the stud in supporting control column loads is provided in the new design by pin 27-21169-005. The pin rotates on the inner race of a roller bearing installed in fitting 27-21169-007. The pin has a diameter of 0.500 inch, a fillet radius of 0.020 inch, and is made from 17-4 PH steel. The enlarged diameter of the pin decreases the c/I ratio of the design from 652 in^{-3} to just 82 in^{-3} - a factor of 8 reduction.

To check the resistance of the new design to crack propagation, the bending stress at the fillet radius was calculated based on 25 lbs pilot effort and the control column geometry of page 2.1, reference 9. Reference 8 gives a stress concentration factor of about 2.0 for this pin geometry subjected to a moment. In this case, the moment is the pilot effort (25 lbs) plus the resulting stick pusher load (113 lbs) times half the length of the pin head (0.35/2 = 0.175 inch) or 24 in-lbs. The alternating bending stress is then $2.0 \times (24 \text{ in-lbs}) \times 82 \text{ in}^{-3}$, or about 4,000 psi. At this stress level, an assumed 0.05-inch-deep by 0.11-inch-wide crack will not to grow as predicted by NASGRO crack case SC07 (see output file in Appendix C).

9. LANDING GEAR GROUP

9.1 PSE LG2 SA226 AND SA227 LANDING GEAR CYLINDER (5453001-1,-3) UNDER 14,000 LBS LANDING WEIGHT

Several operators have reported cracks in the cylinder (part number (P/N) 5453001), along the radius where the side strut blends into the drag brace boss. The cracks were found after about 12,500 landings [10] and were the result of spring back loads. Frequent inspection of both part numbers 5453001-1 and 5453001-3 is required per Service Bulletins 226-32-033 and 227-32-022 as well as the Airframe Airworthiness Limitations Manual. These documents specify inspection thresholds of 8,000 hours for the 5453001-1 part and 10,000 hours for the 5453001-3 part. The repeating inspection interval for both parts is 800 hours if no cracks are found and 50 hours if cracks are successfully dressed out. If cracks reappear or cannot be dressed out within limits, the cylinder must be replaced.

Other cracks have occurred in the 2014-T6 yoke forging, which is shrunk fit onto the steel landing gear piston. There is a retaining pin through the assembly that also serves as a method to introduce an air charge into the oleo strut. The hole for the pin causes a stress concentration after assembly. If the interference fit is controlled within tolerance, cracks in the yoke do not arise. Units with excessive interference, however, have been found with cracks prior to installation on any aircraft. This interference has been measured as high as 0.003 inch. At this level, the stress at the hole can reach 45 ksi [1]. This is well above the stress corrosion threshold of 2014-T4 material in the short transverse direction.

Because load fluctuation is not the cause of the cracks, their growth rate is not calculated with the methods in this report. However, inspection Service Bulletins 226-32-065 and 227-23-039 have been issued for ultrasonic inspection of all yokes installed on Ozone main landing gear part numbers OAS5453 through –19 and nose gear part numbers OAS5451 through –17. Units with acceptably small cracks must be reinspected at times varying between 100 and 1000 hours depending on crack length. Examination of cracked units has shown relatively slow growth as the crack gets further from the hole.

10. ONSET OF WIDESPREAD FATIGUE DAMAGE (WFD)

Widespread Fatigue Damage (WFD) in a structure is characterized by the presence of cracks at several, adjacent structural details or structural elements. When such cracks grow in size in density, there comes a point at which the structure can no longer meet its damage tolerance requirement. WFD can occur as Multiple-Site Damage (MSD) or as Multiple-Element Damage (MED).

MSD is characterized by the simultaneous presence of fatigue cracks in the same structural element. Simultaneous cracking at multiple locations occurs when a particular structural feature is replicated many times and exposed to a near-uniform stress at all locations. Examples of such structure in the SA226 and SA227 are the T-stringer and skin at the crown and belly of the fuselage and the cargo door hinge.

MED is characterized by the simultaneous presence of fatigue cracks in similar adjacent structural elements in a multiload path component. Chordwise wing skin splices in the SA226 and SA227 are examples of such structure.

Initially, such cracks may be nonuniform in size and grow independently of one another. They begin to interact with their neighbors as they grow. Interaction can result in a significant increase in crack propagation rate and/or a reduction in residual strength capability. Due to their relatively small sizes, they are difficult to detect and thus pose the risk of sudden coalescent and total structural failure without warning. Damage due to external sources – a failed propeller blade, for instance – superposed on WFD can also be catastrophic.

One assumption made regarding WFD in this report is that the analysis may consider only average quality flaws in the adjacent structural elements. Although a rogue flaw must be assumed when considering the time to critical crack size in a PSE, the probability of rogue flaws occurring at multiple sites or elements in adjacent structure is extremely remote and may be neglected.

On the preceding basis the SA226 full-scale fatigue test provides valuable information about the susceptibility of the SA226 and SA227 aircraft to WFD during the operation life goal of 50,000 hours. Near the conclusion of the 105,000-hour test, a 5-inch longitudinal saw cut was made in the skin and T-stringer at the crown of the fuselage. The application of the 7-psi differential pressure did not cause unstable growth of this cut. In addition, no other areas of the pressure vessel failed catastrophically before completion of the test. Cracks that did grow were clearly visible and were either repaired or monitored further.

Saw cuts were also made in the main wing spar just before completion of the test. Application of limit load caused no catastrophic failures in any of the spar elements or chordwise skin splices.

In addition, it is important to note that the operator survey conducted in Phase I showed that for all three flight profiles (commuter, cargo, and executive) the stress spectrum is less severe than that used for the full-scale fatigue test. Therefore, the time to onset of WFD for the wing, fuselage, and tail structure is determined to be greater than 105,000 hours with a high degree of certainty and greater than 50,000 hours (the goal of this program) with a very high degree of certainty.

11. SUMMARY OF RESULTS

Table 11-1 summarizes the results of crack growth analysis for each PSE. Observed cracks from fatigue testing as well as operator field reports are also listed for comparison to the analytical results. The observed lives represent the time at which the crack was discovered; at which point the structure would generally be repaired so the time to failure is not known.

Table 11-2 summarizes the inspection intervals that follow from the crack growth analyses. Not all PSE's have an inspection program, as some were shown to have long lives or corrective service bulletins. The numbers in italics indicate inspections that are currently specified in the Airframe Airworthiness Limitations Manual.

TABLE 11-1 SUMMARY OF CRACK GROWTH ANALYSIS RESULTS

PSE	DESCRIPTION	OBSERVED LIFE (hrs)*	ANALYSIS LIFE (hrs)	CRITICAL CRACK LENGTH (in)	CRACK GROWTH ANALYSIS METHOD
W1	226 Main spar lower cap @ WS 99.0		38,500	0.52	NASGRO CC02/TC03/TC02
W2	226 Main spar lower cap @ WS 9.0		22,000	0.51	NASGRO CC02/TC03/TC02
W3	226 Rear spar lower cap @ WS 27.0	96,500	15,400	0.28	NASGRO CC02/TC03/TC02
W4	227 Main spar lower cap @ WS 99.0		37,400	0.73	NASGRO CC02/TC03/TC02
W5	227 Skin splice lower surface @ WS 99.51		11,800	0.64	NASGRO TC05
W6	227 Main spar lower surface wing tip extension fitting		>440,000	N/A	NASGRO TC03
W7	227 Lower wing skin on forward side of landing gear trunnion @ WS 113	11,000	17,000	0.17	NASGRO TC03
W8	226/227 Chordwise skin splice lower surface @ WS 173.944		176,000	0.47	NASGRO TC05
W9	226/227 Skin splice lower surface outboard of rib @ WS 27.103		17,600	0.34	*By Similarity to PSE W10*
W10	226/227 Skin splice lower surface inboard of splice @ WS 27.103	88,872	17,600	0.34	NASGRO TC05
W11	226 Wing skin lower center section at landing light cutout	42,623	22,000	0.89	NASGRO TC01
W12	227 Rear spar lower surface wing tip extension fitting		>165,000	N/A	NASGRO TC03
W13	227 Rear spar lower surface at end of outboard extension fitting @ WS 270.12		90,750	0.28	NASGRO TC03
W14	227 Main spar lower surface at end of outboard extension fitting @ WS 271.02		>115,500	N/A	NASGRO TC03
F1	226 T-stringer at top centerline near FS 330		>385,000	N/A	NASGRO TC05
F2	226/227 Wing-fuselage forward attachment fittings		Infinite	N/A	*Compressive Strain*
F3	226/227 Wing-fuselage aft attachment fittings		Infinite	N/A	*Compressive Strain*
F4	226/227 Fuselage frame at fore/aft cargo door latches @ FS 454.5/455.7 and 473.4/474.6		Infinite	N/A	*Compressive Strain*
F5	226/227 Fuselage frame at fore/aft cargo door latches @ FS 455.7/473.4		330,000 cyc	1.00	NASGRO TC02
F6	226/227 Fuselage frame at cargo door sides		Infinite	N/A	*Compressive Strain*
F7	226/227 Cargo door hinge		13,200 cyc	0.15	NASGRO CC01
F8	226/227 Corners of passenger window cutouts	72,000	-	-	*226 Full-Scale Fatigue Test*
F9	226 T-stringer at bottom centerline aft of FS 362		>385,000	N/A	*By Similarity to PSE F1*
F10	226/227 Cargo door opening corners	74,753	300,000 cyc	0.26	NASGRO TC02
F11	226/227 Forward pressure bulkhead		372,000 cyc	0.41	NASGRO TC02
F12	226/227 Passenger door opening corners	51,700	-	-	*226 Full-Scale Fatigue Test*
F13	226/227 Control column roller bearing		Infinite	N/A	NASGRO SC07
H1	226/227 Rib strap at horizontal stabilizer rear spar @ BL 3.135		>115,000	N/A	NASGRO TC03
H2	226/227 Horizontal stabilizer pitch trim actuator fittings		>115,000	N/A	NASGRO TC02
N1	226/227 Nacelle upper longeron at firewall		159,000	0.91	NASGRO TC03
N2	226/227 Nacelle upper longeron at attachment to wing rib attach angles at main spar		>115,500	N/A	NASGRO TC05
N3	226/227 Nacelle upper longeron to wing rib attach angles at wing rib		129,800	0.49	NASGRO TC02
V1	226/227 Vertical fin main spar cap strips at bottom of pivot fitting		Infinite	N/A	NASGRO TC03
EM1	227 Engine mount at firewall		Infinite	N/A	NASGRO TC01
LG2	226/227 Landing gear cylinder 5453001-1,-3	12,500 cyc	-	-	*Service Reports*

Time when crack was discovered, not time to failure. "N/A" = critical length not reached prior to end of run. "Infinite" = rogue flaw did not grow.

TABLE 11-2 SUMMARY OF INSPECTION INTERVALS

PSE	NDI METHOD	MIN NDI SIZE (in)	TIME TO MIN SIZE (hrs)	CRITICAL SIZE (in)	TIME TO CRITICAL (hrs)	FIRST INSP (hrs)	REPEAT INSP (hrs)
W1	E	0.10	24,750	0.80	49,500	24,750	2,750
W2	E	0.10	13,750	0.43	28,600	14,300	10,000
W3	E	0.10	7,700	0.44	33,000	16,500	2,000
W4	E	0.10	27,500	1.00	40,700	20,000	5,000
W5							
W6							
W7							
W8							
W9	E	0.15	8,250	2.80	23,600	11,800	5,500
W10	E	0.15	8,250	2.80	23,600	11,800	5,500
W11	E	0.15	16,500	0.89	22,000	11,000	2,500
W12							
W13							
W14							
F1							
F2							
F3							
F4	P or E					*17,000*	*1,000*
F5	P or E					*17,000*	*1,000*
F6	P or E					*17,000*	*1,000*
F7	E	0.10	74,000 cyc	0.13	75,000 cyc	37,500 cyc	1,000 cyc
F8	P or E					*23,000*	*3,000*
F9							
F10	P or E					*23,000*	*3,000*
F11							
F12	P or E					*10,000*	*2,000*
F13							
H1	P or E					*30,000*	*2,000*
H2							
N1							
N2							
N3							
V1							
EM1							
LG2	P or E					*4,000*	*800*

NDI Methods: "V" = visual, "P" = penetrant, "E" = eddy current, "X" = x-ray, "M" = magnetic particle

Inspection times in *italics* are taken from the Airframe Airworthiness Limitations Manual

12. REFERENCES

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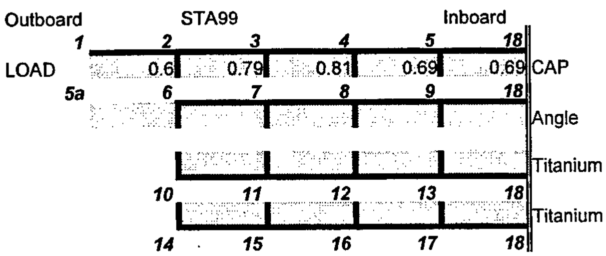
APPENDIX A STRESS ANALYSES AND STIFFNESS MODELS

A-1 PSE W1 Stiffness Models

PSE W1 - MAIN SPAR, LOWER CAP AT WING STATION 99.00 FOR SA226

Main Spar Lower Surface



FASTENER PROPERTY

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

Stresses

	Taxi	1 g	sigma/g	Landing
commuter	-10000	5497	6111	4600

		Thk	1 Row W	Area	Eff. Area	Full W/2
Bottom 1	Titanium	0.125	0.55	0.06875		1.1
Bottom 2	Titanium	0.125	0.55	0.06875		1.1
Top	Angle	0.125	0.7	0.0875		1.4
Top	Cap	0.125	0.7	0.0875		1.4
				0.0875		

APPLIED LOAD = 1.000 cap, stress * area
APPLIED LOAD = 0.977 angle, 97.7% of applied load

A-1 PSE W1 Stiffness Models (Continued)

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)	
1.5.E+06	1	2	CAP	0.0875	1.0E+07	0.60						
1.1.E+06	2	3	CAP	0.0875	1.0E+07	0.79						
1.1.E+06	3	4	CAP	0.0875	1.0E+07	0.81						
1.3.E+06	4	5	CAP	0.0875	1.0E+07	0.69						
1.3.E+06	5	18	CAP	0.0875	1.0E+07	0.69						
1.5.E+06	5a	6	ANGLE	0.0875	1.0E+07	0.60						
1.1.E+06	6	7	ANGLE	0.0875	1.0E+07	0.79						
1.1.E+06	7	8	ANGLE	0.0875	1.0E+07	0.81						
1.3.E+06	8	9	ANGLE	0.0875	1.0E+07	0.69						
1.3.E+06	9	18	ANGLE	0.0875	1.0E+07	0.69						
1.4.E+06	10	11	Strap 1	0.06875	1.6E+07	0.79						
1.4.E+06	11	12	Strap 1	0.06875	1.6E+07	0.81						
1.6.E+06	12	13	Strap 1	0.06875	1.6E+07	0.69						
1.6.E+06	13	18	Strap 1	0.06875	1.6E+07	0.69						
1.4.E+06	14	15	Strap 2	0.06875	1.6E+07	0.79						
1.4.E+06	15	16	Strap 2	0.06875	1.6E+07	0.81						
1.6.E+06	16	17	Strap 2	0.06875	1.6E+07	0.69						
1.6.E+06	17	18	Strap 2	0.06875	1.6E+07	0.69						
8.3.E+05	2	6	FSTN		1.0E+07		0.16	0.125	0.125	1.667	0.86	cap+angle
8.3.E+05	3	7	FSTN		1.0E+07		0.16	0.125	0.125	1.667	0.86	cap+angle
8.3.E+05	4	8	FSTN		1.0E+07		0.16	0.125	0.125	1.667	0.86	cap+angle
8.3.E+05	5	9	FSTN		1.0E+07		0.16	0.125	0.125	1.667	0.86	cap+angle
1.1.E+06	6	10	FSTN		1.3E+07		0.16	0.125	0.125	1.667	0.86	angle+strap
1.1.E+06	7	11	FSTN		1.3E+07		0.16	0.125	0.125	1.667	0.86	angle+strap
1.1.E+06	8	12	FSTN		1.3E+07		0.16	0.125	0.125	1.667	0.86	angle+strap
1.1.E+06	9	13	FSTN		1.3E+07		0.16	0.125	0.125	1.667	0.86	angle+strap
1.3.E+06	10	14	FSTN		1.6E+07		0.16	0.125	0.125	1.667	0.86	strap+strap
1.3.E+06	11	15	FSTN		1.6E+07		0.16	0.125	0.125	1.667	0.86	strap+strap
1.3.E+06	12	16	FSTN		1.6E+07		0.16	0.125	0.125	1.667	0.86	strap+strap
1.3.E+06	13	17	FSTN		1.6E+07		0.16	0.125	0.125	1.667	0.86	strap+strap

** cap, angle, strap K = [A * E] / L
** fastener E = the E average of the top material and the bottom material.
** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

RESULT

Forces in pounds

Outboard		STA99			Inboard	
	1.00	0.76	0.61	0.54	0.51	*Cap*
1	2	3	4	5	18	
	0.24	0.15	0.07	0.03		*F (Cap-Angle)*
	-0.24	-0.15	-0.07	-0.03		*F (Cap-Angle)*
5a	6	7	8	9	18	
	0.98	0.63	0.52	0.48	0.46	*Angle*
	0.59	0.26	0.11	0.04		*F (Angle-Strap)*
	-0.59	-0.26	-0.11	-0.04		*F (Angle-Strap)*
		0.35	0.46	0.50	0.52	*Strap, Titanium*
	10	11	12	13	18	
	0.24	0.14	0.07	0.03		*F (Strap-Strap)*
	-0.24	-0.14	-0.07	-0.03		*F (Strap-Strap)*
	14	15	16	17	18	
fs		0.24	0.39	0.46	0.48	*Strap, Titanium*

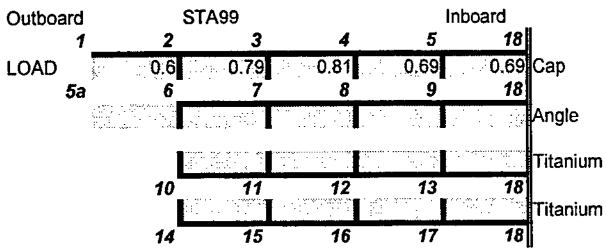
DISPLACEMENT IN INCHES

2.8E-06	2.1E-06	1.4E-06	8.3E-07	4.0E-07	0.0E+00
1	2	3	4	5	18
2.5E-06	1.8E-06	1.2E-06	7.4E-07	3.7E-07	0.0E+00
5a	6	7	8	9	18
	10	11	12	13	18
	1.2E-06	9.8E-07	6.4E-07	3.3E-07	0.0E+00
	14	15	16	17	18
	1.0E-06	8.7E-07	5.9E-07	3.0E-07	0.0E+00

A-1 PSE W1 Stiffness Models (Continued)

PSE W1 - MAIN SPAR, LOWER CAP AT WING STATION 99.00 FOR SA226

Main Spar Lower Surface



FASTENER PROPERTY

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

Stresses

	Taxi	1-g	sigma/g	Landing
commuter	-10000	5497	6111	4600

	Thk	1 Row W	Area	Full W/2
Titanium	0.125	0.55	0.06875	1.1
Titanium	0.125	0.55	0.06875	1.1
Angle	0.125	0.7	0.0875	1.4
Cap	0.125	0.7	0.0875	1.4

APPLIED LOAD = 1.000 cap
APPLIED LOAD = 0.000 angle

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)	
1.5.E+06	1	2	CAP	0.0875	1.0E+07	0.60						
1.1.E+06	2	3	CAP	0.0875	1.0E+07	0.79						
1.1.E+06	3	4	CAP	0.0875	1.0E+07	0.81						
1.3.E+06	4	5	CAP	0.0875	1.0E+07	0.69						
1.3.E+06	5	18	CAP	0.0875	1.0E+07	0.69						
1.7.E+01	5a	6	ANGLE	0.000001	1.0E+07	0.60						
1.3.E+01	6	7	ANGLE	0.000001	1.0E+07	0.79						
1.1.E+06	7	8	ANGLE	0.0875	1.0E+07	0.81						
1.3.E+06	8	9	ANGLE	0.0875	1.0E+07	0.69						
1.3.E+06	9	18	ANGLE	0.0875	1.0E+07	0.69						
1.4.E+06	10	11	Strap 1	0.06875	1.6E+07	0.79						
1.4.E+06	11	12	Strap 1	0.06875	1.6E+07	0.81						
1.6.E+06	12	13	Strap 1	0.06875	1.6E+07	0.69						
1.6.E+06	13	18	Strap 1	0.06875	1.6E+07	0.69						
1.4.E+06	14	15	Strap 2	0.06875	1.6E+07	0.79						
1.4.E+06	15	16	Strap 2	0.06875	1.6E+07	0.81						
1.6.E+06	16	17	Strap 2	0.06875	1.6E+07	0.69						
1.6.E+06	17	18	Strap 2	0.06875	1.6E+07	0.69						
1.0.E-06	2	6	FSTN		1.0E+07		0.16	0.125	0.125	1.667	0.86	cap+angle
4.1.E+05	3	7	FSTN		1.0E+07		0.16	0.125	0.125	1.667	0.86	cap+angle
4.1.E+05	4	8	FSTN		1.0E+07		0.16	0.125	0.125	1.667	0.86	cap+angle
4.1.E+05	5	9	FSTN		1.0E+07		0.16	0.125	0.125	1.667	0.86	cap+angle
1.0.E-06	6	10	FSTN		1.3E+07		0.16	0.125	0.125	1.667	0.86	angle+strap
5.4.E+05	7	11	FSTN		1.3E+07		0.16	0.125	0.125	1.667	0.86	angle+strap
5.4.E+05	8	12	FSTN		1.3E+07		0.16	0.125	0.125	1.667	0.86	angle+strap
5.4.E+05	9	13	FSTN		1.3E+07		0.16	0.125	0.125	1.667	0.86	angle+strap
6.6.E+05	10	14	FSTN		1.6E+07		0.16	0.125	0.125	1.667	0.86	strap+strap
6.6.E+05	11	15	FSTN		1.6E+07		0.16	0.125	0.125	1.667	0.86	strap+strap
6.6.E+05	12	16	FSTN		1.6E+07		0.16	0.125	0.125	1.667	0.86	strap+strap
6.6.E+05	13	17	FSTN		1.6E+07		0.16	0.125	0.125	1.667	0.86	strap+strap
5.4.E+05	10	2	FSTN		1.3E+07		0.16	0.125	0.125	1.667	0.86	strap+cap

** cap, angle, strap K = [A * E] / L

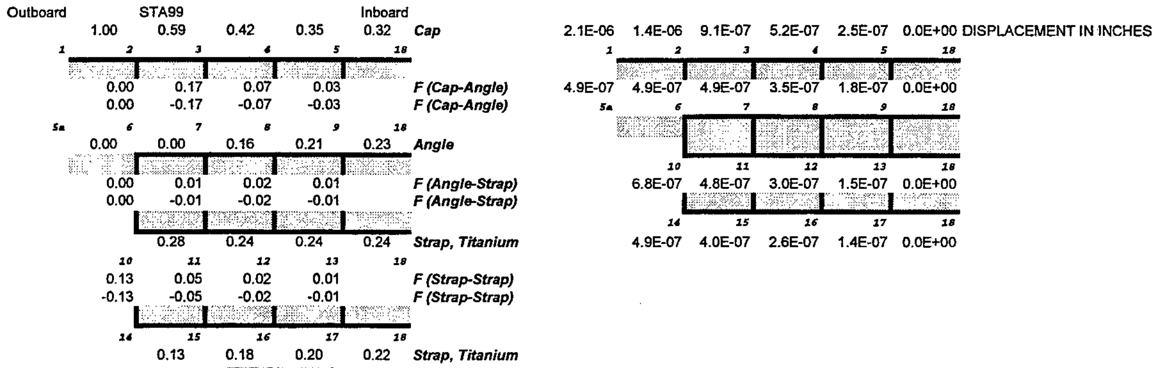
** fastener E = the E average of the top material and the bottom material.

** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])]

A-1 PSE W1 Stiffness Models (Continued)

RESULTS

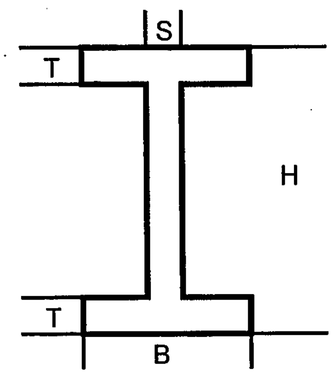
Forces in pounds



A-2 PSE W2 Main Spar Stress Correction WS 13 to WS 9

Find ratio of c/I at WS 13 and c/I at WS 9
Use ratio to adjust WS 13 (measured) stress for WS 9 (PSE)
(Approx. dimensions - for comparison purposes only)

	WS 13	WS 9
Spar Height, H	10.8	9.8
Width, B	3.5	3.5
Flange, T	0.88	0.88
Web, S	0.38	0.38
Intertia		
(BH^3-(B-S)(H-2T)^3)/12	175.3376	139.3875
Ratio c/I(9) to c/I(13)		1.14

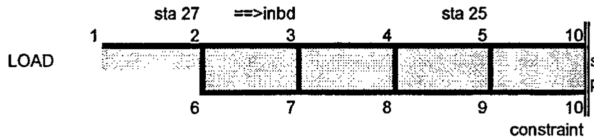


Main spar equivalent I-beam

A-3 PSE W3 Stiffness Model

PSE W3 - SA226 REAR SPAR LOWER ANGLE WS. 27.

Rear Spar Lower Surface Aft Face



FASTENER PROPERTY				
TOP		STEEL	ALUM	Titanium
spar angle FSTNER	C1=	1.667	5.000	4.000
press-angle FSTNER	C2=	0.860	0.800	0.820
BOTTOM				

	Thk	length	Area		effective area
spar angle			0.2976	DS 278	0.15625
press angle	0.125	1.9	0.2375		0.11875
			0.15625		

APPLIED LOAD

APPLY LOAD = 1

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)
781300	1	2	spar a.	0.15625	1.0E+07	2					
1562500	2	3	spar a.	0.15625	1.0E+07	1					
2083300	3	4	spar a.	0.15625	1.0E+07	0.75					
2083300	4	5	spar a.	0.15625	1.0E+07	0.75					
2083300	5	10	spar a.	0.15625	1.0E+07	0.75					
3562500	6	7	pres-a.	0.11875	3.0E+07	1					
4750000	7	8	pres-a.	0.11875	3.0E+07	0.75					
4750000	8	9	pres-a.	0.11875	3.0E+07	0.75					
4750000	9	10	pres-a.	0.11875	3.0E+07	0.75					
979000	2	6	FSTN		2.0E+07		0.25	0.125	0.125	1.667	0.86
905200	3	7	FSTN		2.0E+07		0.20	0.125	0.125	1.667	0.86
905200	4	8	FSTN		2.0E+07		0.20	0.125	0.125	1.667	0.86
905200	5	9	FSTN		2.0E+07		0.20	0.125	0.125	1.667	0.86

** cap, angle, strap K = [A * E] / L

** fastener E = the E average of the top material and the bottom material.

** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

STIFFNESS MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	App Load	Node	Displacemen
7.8E+05	-7.8E+05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00	Node 1	2.21E-06
-7.8E+05	3.3E+06	-1.6E+06	0.0E+00	0.0E+00	-9.8E+05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	Node 2	9.28E-07
0.0E+00	-1.6E+06	4.6E+06	-2.1E+06	0.0E+00	0.0E+00	-9.1E+05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	Node 3	5.53E-07
0.0E+00	0.0E+00	-2.1E+06	5.1E+06	-2.1E+06	0.0E+00	0.0E+00	-9.1E+05	0.0E+00	0.0E+00	0.0E+00	Node 4	3.44E-07
0.0E+00	0.0E+00	0.0E+00	-2.1E+06	5.1E+06	0.0E+00	0.0E+00	0.0E+00	-9.1E+05	-2.1E+06	0.0E+00	Node 5	1.66E-07
0.0E+00	-9.8E+05	0.0E+00	0.0E+00	0.0E+00	4.5E+06	-3.6E+06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	Node 6	5.05E-07
0.0E+00	0.0E+00	-9.1E+05	0.0E+00	0.0E+00	-3.6E+06	9.2E+06	-4.8E+06	0.0E+00	0.0E+00	0.0E+00	Node 7	3.89E-07
0.0E+00	0.0E+00	0.0E+00	-9.1E+05	0.0E+00	0.0E+00	-4.8E+06	1.0E+07	-4.8E+06	0.0E+00	0.0E+00	Node 8	2.70E-07
0.0E+00	0.0E+00	0.0E+00	0.0E+00	-9.1E+05	0.0E+00	0.0E+00	-4.8E+06	1.0E+07	-4.8E+06	0.0E+00	Node 9	1.38E-07
0.0E+00	0.0E+00	0.0E+00	0.0E+00	-2.1E+06	0.0E+00	0.0E+00	0.0E+00	-4.8E+06	6.8E+06	0.0E+00	Node 10	0.00E+00

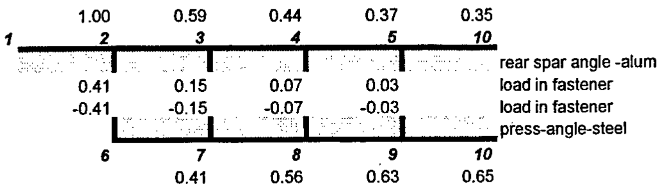
INVERSE MATRIX

									App Load
2.2E-06	9.3E-07	5.5E-07	3.4E-07	1.7E-07	5.1E-07	3.9E-07	2.7E-07	1.4E-07	1
9.3E-07	9.3E-07	5.5E-07	3.4E-07	1.7E-07	5.1E-07	3.9E-07	2.7E-07	1.4E-07	0
5.5E-07	5.5E-07	6.6E-07	3.9E-07	1.8E-07	3.9E-07	3.4E-07	2.5E-07	1.3E-07	0
3.4E-07	3.4E-07	3.9E-07	4.8E-07	2.2E-07	2.7E-07	2.5E-07	2.1E-07	1.1E-07	0
1.7E-07	1.7E-07	1.8E-07	2.2E-07	3.0E-07	1.4E-07	1.3E-07	1.1E-07	7.8E-08	0
5.1E-07	5.1E-07	3.9E-07	2.7E-07	1.4E-07	6.9E-07	4.6E-07	3.0E-07	1.5E-07	0
3.9E-07	3.9E-07	3.4E-07	2.5E-07	1.3E-07	4.6E-07	4.8E-07	3.1E-07	1.5E-07	0
2.7E-07	2.7E-07	2.5E-07	2.1E-07	1.1E-07	3.0E-07	3.1E-07	3.3E-07	1.6E-07	0
1.4E-07	1.4E-07	1.3E-07	1.1E-07	7.8E-08	1.5E-07	1.5E-07	1.6E-07	1.8E-07	0

A-3 PSE W3 Stiffness Model (Continued)

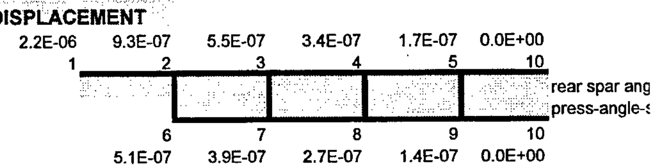
RESULTS

Forces in lbs



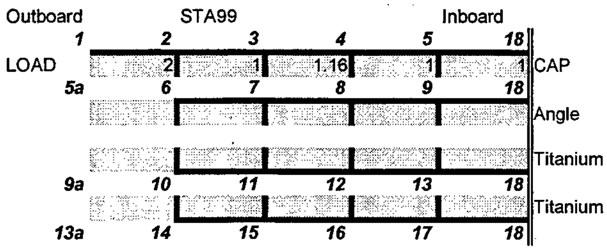
Stiffness	Node #	Node #		Load Between Nodes
7.813E+05	1	2	spar a.	1.00
1.563E+06	2	3	spar a.	0.59
2.083E+06	3	4	spar a.	0.44
2.083E+06	4	5	spar a.	0.37
2.083E+06	5	10	spar a.	0.35
3.563E+06	6	7	pres-a.	0.41
4.750E+06	7	8	pres-a.	0.56
4.750E+06	8	9	pres-a.	0.63
4.750E+06	9	10	pres-a.	0.65
9.790E+05	2	6	FSTN	0.41
9.052E+05	3	7	FSTN	0.15
9.052E+05	4	8	FSTN	0.07
9.052E+05	5	9	FSTN	0.03

DISPLACEMENT



A-4 PSE W4 SA227 Stiffness Models

PSE W4 - MAIN SPAR, LOWER CAP AT WING STATION 99.00 FOR SA227
Main Spar Lower Surface



FASTENER PROPERTY

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

Sprectrum	taxi	Maneuver 1-g	Maneuver Stress/g	landing
commuter	-10000	7523	6898	4600
cargo		7449	6830	
executive		7965	7304	

		Thk	1 Row W	Area	Eff. Area	Full W/2
Bottom 1	Titanium	0.125	0.55	0.06875		1.1
Bottom 2	Titanium	0.125	0.55	0.06875		1.1
Top	Angle	0.125	0.72	0.09		1.44
Top	Cap	0.125	0.72	0.09		1.44

APPLY LOAD, TAXI

		y to cl	Aera Ratio	Material E
APPLY LOAD =	1.00 cap	5.440		
APPLY LOAD =	0.98 angle, 97.7%	5.315		
APPLY LOAD =	1.17 Titanium Strap, bot2	5.190	0.763889	1.6
APPLY LOAD =	1.14 Titanium Strap, bot1	5.065	0.763889	1.6

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)	
4.5.E+05	1	2	CAP	0.09	1.0E+07	2.00						
9.0.E+05	2	3	CAP	0.09	1.0E+07	1.00						
7.8.E+05	3	4	CAP	0.09	1.0E+07	1.16						
9.0.E+05	4	5	CAP	0.09	1.0E+07	1.00						
9.0.E+05	5	18	CAP	0.09	1.0E+07	1.00						
4.5.E+05	5a	6	ANGLE	0.09	1.0E+07	2.00						
9.0.E+05	6	7	ANGLE	0.09	1.0E+07	1.00						
7.8.E+05	7	8	ANGLE	0.09	1.0E+07	1.16						
9.0.E+05	8	9	ANGLE	0.09	1.0E+07	1.00						
9.0.E+05	9	18	ANGLE	0.09	1.0E+07	1.00						
5.5.E+05	9a	10	Strap 1	0.06875	1.6E+07	2.00						
1.1.E+06	10	11	Strap 1	0.06875	1.6E+07	1.00						
9.5.E+05	11	12	Strap 1	0.06875	1.6E+07	1.16						
1.1.E+06	12	13	Strap 1	0.06875	1.6E+07	1.00						
1.1.E+06	13	18	Strap 1	0.06875	1.6E+07	1.00						
5.5.E+05	13a	14	Strap 2	0.06875	1.6E+07	2.00						
1.1.E+06	14	15	Strap 2	0.06875	1.6E+07	1.00						
9.5.E+05	15	16	Strap 2	0.06875	1.6E+07	1.16						
1.1.E+06	16	17	Strap 2	0.06875	1.6E+07	1.00						
1.1.E+06	17	18	Strap 2	0.06875	1.6E+07	1.00						
4.5.E+05	2	6	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
4.5.E+05	3	7	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
4.5.E+05	4	8	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
4.5.E+05	5	9	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
5.9.E+05	6	10	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap
5.9.E+05	7	11	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap
5.9.E+05	8	12	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap
5.9.E+05	9	13	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap
7.2.E+05	10	14	FSTN		1.6E+07		0.200	0.125	0.125	1.667	0.86	strap+strap
7.2.E+05	11	15	FSTN		1.6E+07		0.200	0.125	0.125	1.667	0.86	strap+strap
7.2.E+05	12	16	FSTN		1.6E+07		0.200	0.125	0.125	1.667	0.86	strap+strap
7.2.E+05	13	17	FSTN		1.6E+07		0.200	0.125	0.125	1.667	0.86	strap+strap

** cap, angle, strap K = [A * E] / L

** fastener E = the E average of the top material and the bottom material.

** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

A-4 PSE W4 SA227 Stiffness Models (Continued)

RESULTS

Forces in pounds

Outboard	STA99			Inboard	
	1.00	0.98	0.98	0.97	0.97 *Cap*
1	2	3	4	5	18
	0.02	0.01	0.00	0.00	*F (Cap-Angle)*
	-0.02	-0.01	0.00	0.00	*F (Cap-Angle)*
5a	6	7	8	9	18
	0.98	0.97	0.97	0.97	0.97 *Angle*
	0.02	0.01	0.01	0.00	*F (Angle-Strap)*
	-0.02	-0.01	-0.01	0.00	*F (Angle-Strap)*
	1.17	1.17	1.17	1.17	1.17 *Strap, Titanium*
9a	10	11	12	13	18
	0.02	0.01	0.00	0.00	*F (Strap-Strap)*
	-0.02	-0.01	0.00	0.00	*F (Strap-Strap)*
13a	14	15	16	17	18
	1.14	1.16	1.17	1.17	1.17 *Strap, Titanium*

Displacement In Inches

6.7E-06	4.5E-06	3.4E-06	2.2E-06	1.1E-06	0.0E+00
1	2	3	4	5	18
6.6E-06	4.5E-06	3.4E-06	2.1E-06	1.1E-06	0.0E+00
5a	6	7	8	9	18
9a	10	11	12	13	18
6.6E-06	4.4E-06	3.4E-06	2.1E-06	1.1E-06	0.0E+00
13a	14	15	16	17	18
6.48E-06	4.4E-06	3.4E-06	2.1E-06	1.1E-06	0.0E+00

PSE W4 - MAIN SPAR, LOWER CAP OUTBOARD OF WING STATION 99.00 FOR SA227

Main Spar Lower Surface (Tapered Titanium Strap, outboard)

Outboard	STA130			Inboard		
1	2	3	4	5	18	
LOAD	2	1	1.16	1	1	CAP
5a	6	7	8	9	18	
						Angle
						Titanium
9a	10	11	12	13	18	Titanium
	14	15	16	17	18	

FASTENER PROPERTY

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

Sprectrum	taxi	Maneuver 1-g	Maneuver Stress/g	landing
exec	-10000	7965	7304	4600

		Thk	1 Row W	Area	Eff. Area	Full W/2
Bottom 1	Titanium	0.125	0.55	0.06875		1.1
Bottom 2	Titanium	0.125	0.55	0.06875		1.1
Top	Angle	0.125	0.72	0.09		1.44
Top	Cap	0.125	0.72	0.09		1.44

APPLY LOAD

			y to cl	Area Ratio	Material E	
Stress @WS130	-10000					
APPLY LOAD =	1.00	cap	5.440			
APPLY LOAD =	0.98	angle, 97.7%	5.315			save keeping formula area for load_titanium strap
APPLY LOAD =	1.17	Titanium Strap, bot2	5.190	0.7638889	1.6	0
APPLY LOAD =	0.00	Titanium Strap, bot1	5.065	0.7638889	1.6	0

A-4 PSE W4 SA227 Stiffness Models (Continued)

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)	
4.5.E+05	1	2	CAP	0.0900	1.0E+07	2.00						
9.0.E+05	2	3	CAP	0.0900	1.0E+07	1.00						
7.8.E+05	3	4	CAP	0.0900	1.0E+07	1.16						
9.0.E+05	4	5	CAP	0.0900	1.0E+07	1.00						
9.0.E+05	5	18	CAP	0.0900	1.0E+07	1.00						
4.5.E+05	5a	6	ANGLE	0.0900	1.0E+07	2.00						
9.0.E+05	6	7	ANGLE	0.0900	1.0E+07	1.00						
7.8.E+05	7	8	ANGLE	0.0900	1.0E+07	1.16						
9.0.E+05	8	9	ANGLE	0.0900	1.0E+07	1.00						
9.0.E+05	9	18	ANGLE	0.0900	1.0E+07	1.00						
5.5.E+05	9a	10	Strap 1	0.0688	1.6E+07	2.00						
1.1.E+06	10	11	Strap 1	0.0688	1.6E+07	1.00						
9.5.E+05	11	12	Strap 1	0.0688	1.6E+07	1.16						
1.1.E+06	12	13	Strap 1	0.0688	1.6E+07	1.00						
1.1.E+06	13	18	Strap 1	0.0688	1.6E+07	1.00						thickness
5.5.E+05	14	15	Strap 2	0.0347	1.6E+07	1.00						0.063
6.6.E+05	15	16	Strap 2	0.0481	1.6E+07	1.16						0.088
9.9.E+05	16	17	Strap 2	0.0619	1.6E+07	1.00						0.113
1.1.E+06	17	18	Strap 2	0.0688	1.6E+07	1.00						0.125
4.5.E+05	2	6	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
4.5.E+05	3	7	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
4.5.E+05	4	8	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
4.5.E+05	5	9	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
5.9.E+05	6	10	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap
5.9.E+05	7	11	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap
5.9.E+05	8	12	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap
5.9.E+05	9	13	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap
7.2.E+05	10	14	FSTN		1.6E+07		0.200	0.125	0.125	1.667	0.86	strap+strap
7.2.E+05	11	15	FSTN		1.6E+07		0.200	0.125	0.125	1.667	0.86	strap+strap
7.2.E+05	12	16	FSTN		1.6E+07		0.200	0.125	0.125	1.667	0.86	strap+strap
7.2.E+05	13	17	FSTN		1.6E+07		0.200	0.125	0.125	1.667	0.86	strap+strap

** cap, angle, strap K = [A * E] / L

** fastener E = the E average of the top material and the bottom material.

** fastener K = E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])

RESULT

Forces in pounds

Outboard	STA99			Inboard		
	1.00	0.92	0.85	0.81	0.79	***Cap***
1	*2*	*3*	*4*	*5*	*18*	
	0.08	0.06	0.04	0.02		***F (Cap-Angle)***
	-0.08	-0.06	-0.04	-0.02		***F (Cap-Angle)***
5a	*6*	*7*	*8*	*9*	*18*	
	0.98	0.88	0.81	0.77	0.75	***Angle***
	0.18	0.13	0.08	0.04		***F (Angle-Strap)***
	-0.18	-0.13	-0.08	-0.04		***F (Angle-Strap)***
	1.17	0.98	0.91	0.87	0.85	***Strap, Titanium***
9a	*10*	*11*	*12*	*13*	*18*	
	0.37	0.20	0.12	0.06		***F (Strap-Strap)***
	-0.37	-0.20	-0.12	-0.06		***F (Strap-Strap)***
13a	*14*	*15*	*16*	*17*	*18*	
		0.37	0.57	0.69	0.75	***Strap, Titanium***

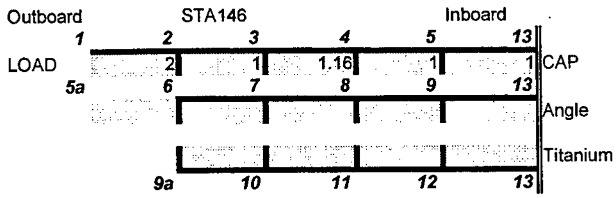
Displacement In Inches

6.1E-06	3.9E-06	2.9E-06	1.8E-06	8.8E-07	0.0E+00
1	*2*	*3*	*4*	*5*	*18*
5.9E-06	3.7E-06	2.7E-06	1.7E-06	8.4E-07	0.0E+00
5a	*6*	*7*	*8*	*9*	*18*
9a	*10*	*11*	*12*	*13*	*18*
5.5E-06	3.4E-06	2.5E-06	1.6E-06	7.7E-07	0.0E+00
13a	*14*	*15*	*16*	*17*	*18*
	2.9E-06	2.24E-06	1.38E-06	6.85E-07	0

A-4 PSE W4 SA227 Stiffness Models (Continued)

PSE W4 - MAIN SPAR, LOWER CAP OUTBOARD OF WING STATION 99.00 FOR SA227

Main Spar Lower Surface (Tapered Titanium Strap, outboard)



FASTENER PROPERTY

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

		Maneuver	Maneuver	
Sprectrum	taxi	1-g	Stress/g	landing
exec	-10000	7965	7304	4600
Scale Factor	0.74655	5946	5453	3434

		Thk	1 Row W	Area	Eff. Area	Full W/2
Bottom 2	Titanium	0.125	0.55	0.06875		1.1
Top	Angle	0.125	0.72	0.09		1.44
Top	Cap	0.125	0.72	0.09		1.44

APPLY LOAD

		y to cl	Area Ratio	Material E
APPLY LOAD =	1.00 cap	5.440		
APPLY LOAD =	0.98 angle, 97.7%	5.315		
APPLY LOAD =	0.00 Titanium Strap, bot1	5.190	0.7638889	1.6

save keeping formula area for load_titanium strap
0

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)	
4.5.E+05	1	2	CAP	0.0900	1.0E+07	2.00						
9.0.E+05	2	3	CAP	0.0900	1.0E+07	1.00						
7.8.E+05	3	4	CAP	0.0900	1.0E+07	1.16						
9.0.E+05	4	5	CAP	0.0900	1.0E+07	1.00						
9.0.E+05	5	13	CAP	0.0900	1.0E+07	1.00						
4.5.E+05	5a	6	ANGLE	0.0900	1.0E+07	2.00						
9.0.E+05	6	7	ANGLE	0.0900	1.0E+07	1.00						
7.8.E+05	7	8	ANGLE	0.0900	1.0E+07	1.16						
9.0.E+05	8	9	ANGLE	0.0900	1.0E+07	1.00						
9.0.E+05	9	13	ANGLE	0.0900	1.0E+07	1.00						
5.5.E+05	9a	10	Strap	0.0347	1.6E+07	1.00						0.063
6.6.E+05	10	11	Strap	0.0481	1.6E+07	1.16						0.088
9.9.E+05	11	12	Strap	0.0619	1.6E+07	1.00						0.113
1.1.E+06	12	13	Strap	0.0688	1.6E+07	1.00						0.125
4.5.E+05	2	6	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
4.5.E+05	3	7	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
4.5.E+05	4	8	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
4.5.E+05	5	9	FSTN		1.0E+07		0.200	0.125	0.125	1.667	0.86	cap+angle
5.9.E+05	6	9a	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap
5.9.E+05	7	10	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap
5.9.E+05	8	11	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap
5.9.E+05	9	12	FSTN		1.3E+07		0.200	0.125	0.125	1.667	0.86	angle+strap

** cap, angle, strap K = [A * E] / L

** fastener E = the E average of the top material and the bottom material.

** fastener K = E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])

A-4 PSE W4 SA227 Stiffness Models (Continued)

RESULT

Forces in pounds

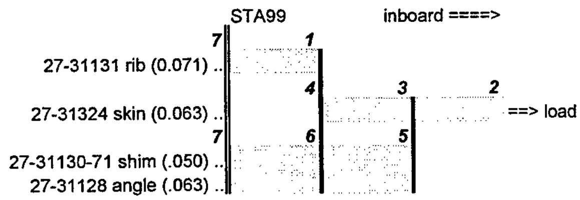
Outboard		STA99			Inboard	
	1.00	0.86	0.77	0.71	0.68	***Cap***
1	2	3	4	5	13	
	0.18	0.11	0.05	0.03		***F (Cap-Angle)***
	-0.18	-0.11	-0.05	-0.03		***F (Cap-Angle)***
5a	6	7	8	9	13	
	0.98	0.78	0.70	0.65	0.63	***Angle***
	0.33	0.18	0.11	0.05		***F (Angle-Strap)***
	-0.33	-0.18	-0.11	-0.05		***F (Angle-Strap)***
	9a	10	11	12	13	
		0.33	0.51	0.62	0.67	***Strap, Titanium***

Displacement In Inches

5.7E-06	3.5E-06	2.5E-06	1.5E-06	7.6E-07	0.0E+00
1	2	3	4	5	13
5.4E-06	3.2E-06	2.3E-06	1.4E-06	7.0E-07	0.0E+00
5a	6	7	8	9	13
	9a	10	11	12	13
	2.61E-06	2.0E-06	1.24E-06	6.1E-07	0.0E+00

A-5 PSE W5 Stiffness Models

PSE W-5 - WING SKIN SPLICE AT WS99, SA227 Inboard



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FASTENER PROPERTY	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

		Maneuver		
Spectrum	taxi	1-g	Stress/g	landing
commuter	0	7523	6898	4600
cargo		7449	6830	
executive		7965	7304	

Taxi Spectrum = compression
Landing Spectrum = Gage 23, Table D-8, no correction
Maneuver = Table E-11, Main Spar Data Used

APPLIED LOAD

APPLIED LOAD = 1.0

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	THK	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)
9.1.E+05	1	7	rib	0.0568	0.071	1.0E+07	0.63					
8.1.E+05	2	3	skin	0.0504	0.063	1.0E+07	0.63					
8.1.E+05	3	4	skin	0.0504	0.063	1.0E+07	0.63					
1.4.E+06	5	6	shim+ang	0.0904	0.113	1.0E+07	0.63					
1.4.E+06	6	7	shim+ang	0.0904	0.113	1.0E+07	0.63					
1.8.E+05	1	4	FSTN	rib-skin		1.0E+07		0.156	0.071	0.063	5	0.8
1.9.E+05	3	5	FSTN	skin-shim		1.0E+07		0.156	0.063	0.113	5	0.8
1.9.E+05	4	6	FSTN	skin-shim		1.0E+07		0.156	0.063	0.113	5	0.8

** cap, angle, strap K = [A * E] / L
** fastener E = avg of top and bottom material.
** fastener K= E*D/ (C1+C2 * [D/ThkTop+D/ThkBott])^2

STIFFNESS MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7		App Load	Displacement
1.1E+06	0.0E+00	0	-1.8.E+05	0	0	-9.1.E+05	Node 1	0	3.4E-07
0.0E+00	8.1E+05	-8.1E+05	0	0.0.E+00	0	0	Node 2	1	4.0E-06
0	-8.1E+05	1.8E+06	-8.1E+05	-1.9.E+05	0.0.E+00	0	Node 3	0	2.8E-06
-1.8.E+05	0	-8.1E+05	1.2E+06	0.0E+00	-1.9.E+05	0.0.E+00	Node 4	0	2.0E-06
0	0.0.E+00	-1.9.E+05	0.0E+00	1.6E+06	-1.4E+06	0	Node 5	0	7.5E-07
0	0	0.0.E+00	-1.9.E+05	-1.4E+06	3.1E+06	-1.4E+06	Node 6	0	4.8E-07
-9.1.E+05	0	0	0.0.E+00	0	-1.4E+06	2.4E+06	Node 7	0	0.0E+00
Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7			

INVERSE MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	
9.8E-07	3.4E-07	3.4E-07	3.9E-07	1.0E-07	7.3E-08		Node 1
3.4E-07	4.0E-06	2.8E-06	2.0E-06	7.5E-07	4.8E-07		Node 2
3.4E-07	2.8E-06	2.8E-06	2.0E-06	7.5E-07	4.8E-07		Node 3
3.9E-07	2.0E-06	2.0E-06	2.4E-06	6.3E-07	4.5E-07		Node 4
1.0E-07	7.5E-07	7.5E-07	6.3E-07	1.3E-06	6.3E-07		Node 5
7.3E-08	4.8E-07	4.8E-07	4.5E-07	6.3E-07	6.5E-07		Node 6
							Node 7

A-5 PSE W5 Stiffness Models (Continued)

RESULTS

7	1			
load between nodes	0.30			
fastener loads	-0.30			
	4	3	2	
load between nodes		0.61	1.00	==> load
fastener loads	0.30	0.39		
7	6	5		
load between nodes	0.70	0.39		

load = Stiffness * (Displacement Node #1 - Displacement Node #2)

Stiffness, K	Node #	Node #	Load Between Nodes	
9.1.E+05	1	7	rib	0.30
8.1.E+05	2	3	skin	1.00
8.1.E+05	3	4	skin	0.61
1.4.E+06	5	6	shim+ang	0.39
1.4.E+06	6	7	shim+ang	0.70
1.8.E+05	1	4	FSTN	-0.30
1.9.E+05	3	5	FSTN	0.39
1.9.E+05	4	6	FSTN	0.30

PSE W-5 - WING SKIN SPLICE AT WS99, SA227 Outboard

<==== inboard	STA99		out board ====>		
	9	4	3	2	1
27-31321 skin (0.032) ..					==>>> load
	9	7	6	5	
27-31130-73 shim (0.032) ..					
	9	8			
27-31130-71 shim (.050) ..					
	====>> positive				

FASTENER PROPERTY

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

		Maneuver		
Sprectrum	taxi	1-g	Stress/g	landing
commuter	0	7523	6898	4600
cargo		7449	6830	
executive		7965	7304	

APPLY LOAD, LANDING

Assume Splice Width	0.026	width .800, thk = .032
Stress	4600	same as PSE W-3
APPLY LOAD =	118	area of outboard skin

Taxi Spectrum = compression
Landing Spectrum = Gage 23, Table D-8, no correction
Maneuver = Table E-11, Main Spar Data Used

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	THK	E	L	D	thk-top	thk-bott	C1 (cont)	C2 (cont)
1.3.E+05	1	2	SKIN 032	0.0256	0.032	1.0E+07	2.00					
4.3.E+05	2	3	SKIN 032	0.0256	0.032	1.0E+07	0.60					
4.3.E+05	3	4	SKIN 032	0.0256	0.032	1.0E+07	0.60					
6.4.E+05	4	9	SKIN 032	0.0256	0.032	1.0E+07	0.40					
4.3.E+05	5	6	shim 032	0.0256	0.032	1.0E+07	0.60	** cap, angle, strap K = [A * E] / L				
4.3.E+05	6	7	shim 032	0.0256	0.032	1.0E+07	0.60	** fastener E = avg of top and bottom material.				
6.4.E+05	7	9	shim 032	0.0256	0.032	1.0E+07	0.40	** fastener K= E*D/ (C1+C2 * [D/ThkTop+D/ThkBott])]^:				
1.0.E+06	8	9	shim 050	0.0400	0.050	1.0E+07	0.40					
1.1.E+05	2	5	FSTN	Skin + shim 032		1.0E+07		0.130	0.032	0.032	5	0.8
1.1.E+05	3	6	FSTN	Skin + shim 032		1.0E+07		0.130	0.032	0.032	5	0.8
1.2.E+05	4	7	FSTN	Skin + shim 032		1.0E+07		0.162	0.032	0.032	5	0.8
1.4.E+05	7	8	FSTN	Shim +shim		1.0E+07		0.162	0.032	0.050	5	0.8

A-5 PSE W5 Stiffness Models (Continued)

STIFFNESS MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9		App Load	Displacement
1.3E+05	-1.3E+05	0	0	0	0	0	0	0	Node 1	118	1.4E-03
-1.3E+05	6.7E+05	-4.3E+05	0	-1.1.E+05	0	0	0	0	Node 2	0	4.9E-04
0	-4.3E+05	9.7E+05	-4.3E+05	0	-1.1.E+05	0	0	0	Node 3	0	2.8E-04
0	0	-4.3E+05	1.2E+06	0.0E+00	0	-1.2.E+05	0	-6.4.E+05	Node 4	0	1.1E-04
0	-1.1.E+05	0	0.0E+00	5.4E+05	-4.3E+05	0	0	0	Node 5	0	2.3E-04
0	0	-1.1.E+05	0	-4.3E+05	9.7E+05	-4.3E+05	0	0	Node 6	0	1.6E-04
0	0	0	-1.2.E+05	0	-4.3E+05	1.3E+06	-1.4E+05	-6.4.E+05	Node 7	0	6.3E-05
0	0	0	0	0	0	-1.4E+05	1.1E+06	-1.0E+06	Node 8	0	7.8E-06
0	0	0	-6.4.E+05	0	0	-6.4.E+05	-1.0E+06	2.3E+06	Node 9	0	0.0E+00
Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9			

INVERSE MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	
1.2E-05	4.2E-06	2.4E-06	9.2E-07	2.0E-06	1.4E-06	5.4E-07	6.6E-08		Node 1
4.2E-06	4.2E-06	2.4E-06	9.2E-07	2.0E-06	1.4E-06	5.4E-07	6.6E-08		Node 2
2.4E-06	2.4E-06	2.7E-06	1.0E-06	1.4E-06	1.1E-06	4.7E-07	5.7E-08		Node 3
9.2E-07	9.2E-07	1.0E-06	1.2E-06	5.9E-07	5.0E-07	2.8E-07	3.4E-08		Node 4
2.0E-06	2.0E-06	1.4E-06	5.9E-07	4.1E-06	2.3E-06	8.2E-07	1.0E-07		Node 5
1.4E-06	1.4E-06	1.1E-06	5.0E-07	2.3E-06	2.6E-06	8.9E-07	1.1E-07		Node 6
5.4E-07	5.4E-07	4.7E-07	2.8E-07	8.2E-07	8.9E-07	1.1E-06	1.3E-07		Node 7
6.6E-08	6.6E-08	5.7E-08	3.4E-08	1.0E-07	1.1E-07	1.3E-07	8.9E-07		Node 8
									Node 9

RESULT, MANEUVER, LANDING

Forces in pounds

<==== inboard STA99 out board ====>

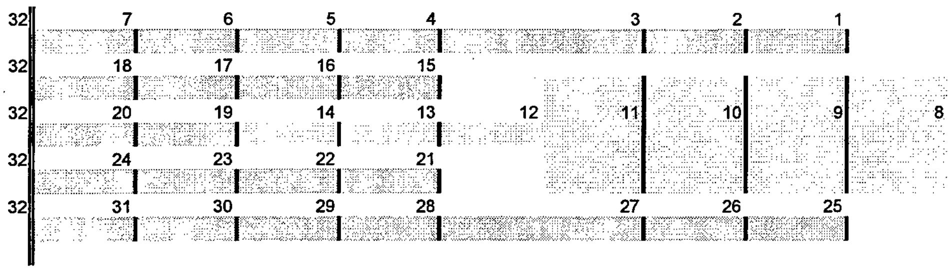
	9	4	3	2	1
27-31321 skin (0.032) ..	69	75	88	118	
fastener loads		6	14	29	|||==>>> load
	9	7	6	5	
27-31130-73 shim (0.032) ..	41	43	29		
fastener loads		8			
	9	8			
27-31130-71 shim (.050) ..	8				

load = Stiffness * (Displacement Node #1 - Displacement Node #2)

Stiffness, E	Node #	Node #	Load Between Nodes	
1.3E+05	1	2	SKIN 032	118
4.3E+05	2	3	SKIN 032	88
4.3E+05	3	4	SKIN 032	75
6.4E+05	4	9	SKIN 032	69
4.3E+05	5	6	shim 032	29
4.3E+05	6	7	shim 032	43
6.4E+05	7	9	shim 032	41
1.0E+06	8	9	shim 050	8
1.1E+05	2	5	FSTN	29
1.1E+05	3	6	FSTN	14
1.2E+05	4	7	FSTN	6
1.4E+05	7	8	FSTN	8

A-6 PSE W6 Stiffness Model

PSE W6 - SA227 TIP EXTENSION AT END OF OUTBOARD FITTING @ 16,500 lbs
Main Spar Lower Surface,



	Strip Areas
Angle	0.0504
Strap	0.0568
mid Strap	0.119
Fitting	0.238
	0.119
Strap	0.0568
Angle+Dblr	0.0904

FASTENER PROPERTY				
TOP		STEEL	ALUM	Titanium
FSTNER	C1=	1.667	5.000	4.000
FSTNER	C2=	0.860	0.800	0.820
BOTTOM				

APPLIED LOAD

APPLIED LOAD = 1.0

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)
672000	1	2	Top Angle	0.0504	1.0E+07	0.75					
672000	2	3	Top Angle	0.0504	1.0E+07	0.75					
672000	3	4	Top Angle	0.0504	1.0E+07	0.75					
672000	4	5	Top Angle	0.0504	1.0E+07	0.75					
672000	5	6	Top Angle	0.0504	1.0E+07	0.75					
672000	6	7	Top Angle	0.0504	1.0E+07	0.75					
672000	7	32	Top Angle	0.0504	1.0E+07	0.75					
9361300	8	9	Fitting	0.238	3.0E+07	0.75					
9361300	9	10	Fitting	0.238	3.0E+07	0.75					
9361300	10	11	Fitting	0.238	3.0E+07	0.75					
18722700	11	12	Fitting	0.238	3.0E+07	0.375					
9361300	12	13	Fitting	0.119	3.0E+07	0.375					
4680700	13	14	Fitting	0.119	3.0E+07	0.75					
757300	15	16	Top Strap	0.0568	1.0E+07	0.75					
757300	16	17	Top Strap	0.0568	1.0E+07	0.75					
757300	17	18	Top Strap	0.0568	1.0E+07	0.75					
757300	18	32	Top Strap	0.0568	1.0E+07	0.75					
1586700	19	20	Mid Strap	0.119	1.0E+07	0.75					
1586700	20	32	Mid Strap	0.119	1.0E+07	0.75					
757300	21	22	Bot Strap	0.0568	1.0E+07	0.75					
757300	22	23	Bot Strap	0.0568	1.0E+07	0.75					
757300	23	24	Bot Strap	0.0568	1.0E+07	0.75					
757300	24	32	Bot Strap	0.0568	1.0E+07	0.75					
1205300	25	26	Bot Ang	0.0904	1.0E+07	0.75					
1205300	26	27	Bot Ang	0.0904	1.0E+07	0.75					
1205300	27	28	Bot Ang	0.0904	1.0E+07	0.75					
1205300	28	29	Bot Ang	0.0904	1.0E+07	0.75					
1205300	29	30	Bot Ang	0.0904	1.0E+07	0.75					
1205300	30	31	Bot Ang	0.0904	1.0E+07	0.75					

A-6 PSE W6 Stiffness Model (Continued)

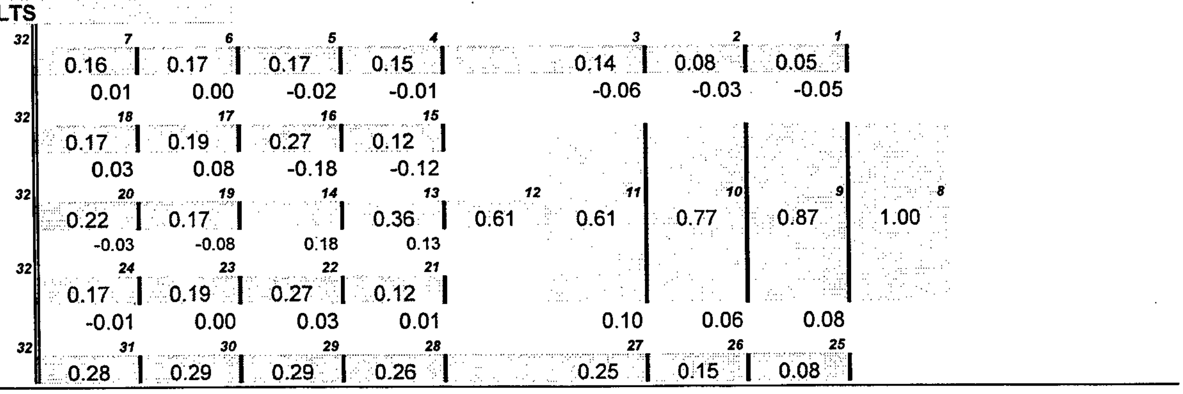
								thk-top	thk-bott		
1205300	31	32	Bot Ang	0.0904	1.0E+07	0.75					
784400	1	9	FSTN		2.0E+07		0.19	0.063	0.28	1.667	0.86
784400	2	10	FSTN		2.0E+07		0.19	0.063	0.28	1.667	0.86
784400	3	11	FSTN		2.0E+07		0.19	0.063	0.28	1.667	0.86
289500	4	15	FSTN		1.0E+07		0.19	0.063	0.071	1.667	0.86
289500	5	16	FSTN		1.0E+07		0.19	0.063	0.071	1.667	0.86
289500	6	17	FSTN		1.0E+07		0.19	0.063	0.071	1.667	0.86
289500	7	18	FSTN		1.0E+07		0.19	0.063	0.071	1.667	0.86
1028000	9	25	FSTN		2.0E+07		0.19	0.28	0.113	1.667	0.86
1028000	10	26	FSTN		2.0E+07		0.19	0.28	0.113	1.667	0.86
1028000	11	27	FSTN		2.0E+07		0.19	0.28	0.113	1.667	0.86
739900	13	21	FSTN		2.0E+07		0.19	0.14	0.071	1.667	0.86
739900	14	22	FSTN		2.0E+07		0.19	0.14	0.071	1.667	0.86
739900	15	13	FSTN		2.0E+07		0.19	0.071	0.14	1.667	0.86
739900	16	14	FSTN		2.0E+07		0.19	0.071	0.14	1.667	0.86
370000	17	19	FSTN		1.0E+07		0.19	0.071	0.14	1.667	0.86
370000	18	20	FSTN		1.0E+07		0.19	0.071	0.14	1.667	0.86
370000	19	23	FSTN		1.0E+07		0.19	0.14	0.071	1.667	0.86
370000	20	24	FSTN		1.0E+07		0.19	0.14	0.071	1.667	0.86
350900	21	28	FSTN		1.0E+07		0.19	0.071	0.113	1.667	0.86
350900	22	29	FSTN		1.0E+07		0.19	0.071	0.113	1.667	0.86
350900	23	30	FSTN		1.0E+07		0.19	0.071	0.113	1.667	0.86
350900	24	31	FSTN		1.0E+07		0.19	0.071	0.113	1.667	0.86

** cap, angle, strap K = [A * E] / L

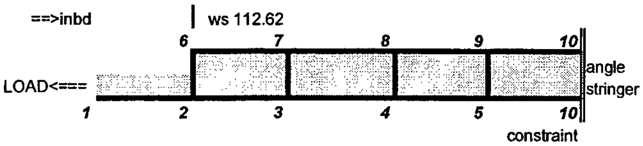
** fastener E = the E average of the top material and the bottom material.

** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

RESULTS



A-7 PSE W7 Stiffness Model



	Matl	Area	
angle	2024-T3 ext	see right	(27-31058)
stringer	2014-T6511	0.104	(27-31330-79/80)
skin	2024-T3	0.03	

FASTENER PROPERTIES

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

Rivets BB 5N D

actual angle area btwn fasteners

1st-2nd	0.203
2nd-3rd	0.214
3rd-4th	0.225
4th-5th	0.236

effective area (plate only)

angle 0.113

APPLIED LOAD

APPLIED LOAD = 1.0

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)
990500	1	2	stringer	0.104	1.0E+07	1.05					
990500	2	3	stringer	0.104	1.0E+07	1.05					
990500	3	4	stringer	0.104	1.0E+07	1.05					
990500	4	5	stringer	0.104	1.0E+07	1.05					
990500	5	10	stringer	0.104	1.0E+07	1.05					
1076200	6	7	angle	0.113	1.0E+07	1.05					
1076200	7	8	angle	0.113	1.0E+07	1.05					
1076200	8	9	angle	0.113	1.0E+07	1.05					
1076200	9	10	angle	0.113	1.0E+07	1.05					
195500	2	6	FSTN		1.0E+07		0.16	0.125	0.063	5	0.8
195500	3	7	FSTN		1.0E+07		0.16	0.125	0.063	5	0.8
195500	4	8	FSTN		1.0E+07		0.16	0.125	0.063	5	0.8
195500	5	9	FSTN		1.0E+07		0.16	0.125	0.063	5	0.8

** stringer,angle K = [A * E] / L

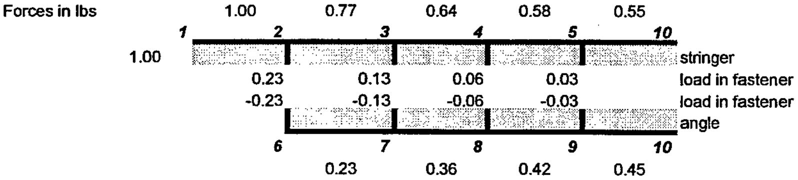
** fastener E = average of the top material E and the bottom material E.

** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

STIFFNESS MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	App Load	Node	Displacement
9.9E+05	-9.9E+05	0	0	0	0	0	0	0	0	1	Node 1	3.568E-06
-9.9E+05	2.2E+06	-9.9E+05	0	0	-2.0E+05	0	0	0	0	0	Node 2	2.558E-06
0	-9.9E+05	2.2E+06	-9.9E+05	0	0	-2.0E+05	0	0	0	0	Node 3	1.785E-06
0	0	-9.9E+05	2.2E+06	-9.9E+05	0	0	-2.0E+05	0	0	0	Node 4	1.138E-06
0	0	0	-9.9E+05	2.2E+06	0	0	0	-2.0E+05	-9.9E+05	0	Node 5	5.554E-07
0	-2.0E+05	0	0	0	1.3E+06	-1.1E+06	0	0	0	0	Node 6	1.362E-06
0	0	-2.0E+05	0	0	-1.1E+06	2.3E+06	-1.1E+06	0	0	0	Node 7	1.145E-06
0	0	0	-2.0E+05	0	0	-1.1E+06	2.3E+06	-1.1E+06	0	0	Node 8	8.110E-07
0	0	0	0	-2.0E+05	0	0	-1.1E+06	2.3E+06	-1.1E+06	0	Node 9	4.180E-07
0	0	0	0	-9.9E+05	0	0	0	-1.1E+06	2.1E+06	0	Node 10	0.000E+00

RESULTS



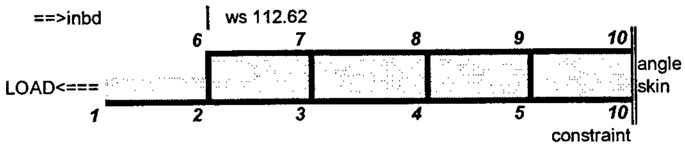
Stiffness	Node #	Node #		Load Between Nodes
9.905E+05	1	2	stringer	1.00
9.905E+05	2	3	stringer	0.77
9.905E+05	3	4	stringer	0.64

DISPLACEMENT

3.6E-06	2.6E-06	1.8E-06	1.1E-06	5.6E-07	0.0E+00
1	2	3	4	5	10

A-7 PSE W7 Stiffness Model (Continued)

Case for stringer broken at last fastener



FASTENER PROPERTIES

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

Rivets BB|5N
D

	Matl	Area
angle	2024-T3 ext	see right (27-31058)
stringer	2014-T6511	0.104 (27-31330-79/80)
skin	2024-T3	0.03

	actual angle area btwn fasteners
1st-2nd	0.203
2nd-3rd	0.214
3rd-4th	0.225
4th-5th	0.236

	effective area (plate only)
angle	0.113

APPLIED LOAD

APPLIED LOAD = 1.0

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)
285700	1	2	stringer	0.030	1.0E+07	1.05					
285700	2	3	stringer	0.03	1.0E+07	1.05					
285700	3	4	stringer	0.03	1.0E+07	1.05					
285700	4	5	stringer	0.03	1.0E+07	1.05					
285700	5	10	stringer	0.03	1.0E+07	1.05					
1076200	6	7	angle	0.113	1.0E+07	1.05					
1076200	7	8	angle	0.113	1.0E+07	1.05					
1076200	8	9	angle	0.113	1.0E+07	1.05					
1076200	9	10	angle	0.113	1.0E+07	1.05					
157600	2	6	FSTN		1.0E+07		0.16	0.125	0.032	5	0.8
157600	3	7	FSTN		1.0E+07		0.16	0.125	0.032	5	0.8
157600	4	8	FSTN		1.0E+07		0.16	0.125	0.032	5	0.8
157600	5	9	FSTN		1.0E+07		0.16	0.125	0.032	5	0.8

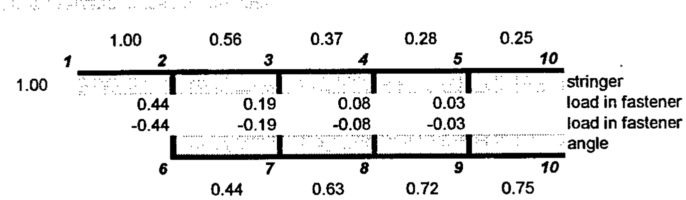
** stringer,angle K = [A * E] / L
** fastener E = average of the top material E and the bottom material E.
** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])]

STIFFNESS MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	App Load	Node	Displacemen
2.9E+05	-2.9E+05	0	0	0	0	0	0	0	0	1	Node 1	8.637E-06
-2.9E+05	7.3E+05	-2.9E+05	0	0	-1.6E+05	0	0	0	0	0	Node 2	5.137E-06
0	-2.9E+05	7.3E+05	-2.9E+05	0	0	-1.6E+05	0	0	0	0	Node 3	3.173E-06
0	0	-2.9E+05	7.3E+05	-2.9E+05	0	0	-1.6E+05	0	0	0	Node 4	1.885E-06
0	0	0	-2.9E+05	7.3E+05	0	0	0	-1.6E+05	-2.9E+05	0	Node 5	8.887E-07
0	-1.6E+05	0	0	0	1.2E+06	-1.1E+06	0	0	0	0	Node 6	2.353E-06
0	0	-1.6E+05	0	0	-1.1E+06	2.3E+06	-1.1E+06	0	0	0	Node 7	1.945E-06
0	0	0	-1.6E+05	0	0	-1.1E+06	2.3E+06	-1.1E+06	0	0	Node 8	1.358E-06
0	0	0	0	-1.6E+05	0	0	-1.1E+06	2.3E+06	-1.1E+06	0	Node 9	6.933E-07
0	0	0	0	-2.9E+05	0	0	0	-1.1E+06	1.4E+06	0	Node 10	0.000E+00

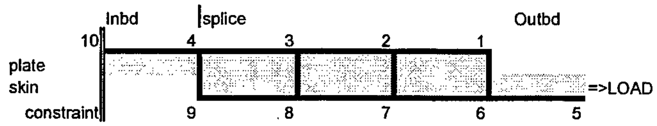
RESULTS

Forces in lbs



A-8 PSE W8 Stiffness Model

PSE W8 - SA226/227 Chordwise skin splice at WS 173.944 lower surface



FASTENER PROPERTIES

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

APPLIED LOAD

APPLIED LOAD = 1.0

	Matl	Thickness	Area
plate	2024-T3	0.032	0.020 (.625 wide strip)
skin	2024-T3	0.025	0.016 (.625 wide strip)

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)
274000	1	2	TOP	0.020	1.0E+07	0.73					
274000	2	3	TOP	0.020	1.0E+07	0.73					
274000	3	4	TOP	0.020	1.0E+07	0.73					
274000	4	10	TOP	0.020	1.0E+07	0.73					
219200	5	6	BOTT	0.016	1.0E+07	0.73					
219200	6	7	BOTT	0.016	1.0E+07	0.73					
219200	7	8	BOTT	0.016	1.0E+07	0.73					
219200	8	9	BOTT	0.016	1.0E+07	0.73					
0	1	6	FSTN		1.0E+07		0.125	1E-08	1E-08	5	0.8
103100	2	7	FSTN		1.0E+07		0.125	0.032	0.025	5	0.8
103100	3	8	FSTN		1.0E+07		0.125	0.032	0.025	5	0.8
0	4	9	FSTN		1.0E+07		0.125	1E-08	1E-08	5	0.8

** cap, angle, strap K = [A * E] / L

** fastener E = the E average of the top material and the bottom material.

** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

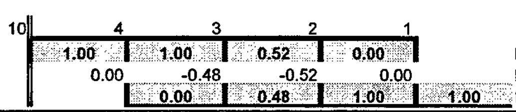
STIFFNESS MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	App Load	Node	Displace
2.74E+05	-2.74E+05	0	0	0	0.00E+00	0	0	0	0	0	Node 1	9.18E-06
-2.74E+05	6.51E+05	-2.74E+05	0	0	0	-1.03E+05	0	0	0	0	Node 2	9.18E-06
0	-2.74E+05	6.51E+05	-2.74E+05	0	0	0	-1.03E+05	0	0	0	Node 3	7.30E-06
0	0	-2.74E+05	5.48E+05	0	0	0	0	0.00E+00	-2.74E+05	0	Node 4	3.65E-06
0	0	0	0	2.19E+05	-2.19E+05	0	0	0	0	1	Node 5	2.33E-05
0.00E+00	0	0	0	-2.19E+05	4.38E+05	-2.19E+05	0	0	0	0	Node 6	1.88E-05
0	-1.03E+05	0	0	0	-2.19E+05	5.42E+05	-2.19E+05	0	0	0	Node 7	1.42E-05
0	0	-1.03E+05	0	0	0	-2.19E+05	5.42E+05	-2.19E+05	0	0	Node 8	1.20E-05
0	0	0	0.00E+00	0	0	0	-2.19E+05	2.19E+05	0	0	Node 9	1.20E-05
0	0	0	-2.74E+05	0	0	0	0	0	2.74E+05	0	Node 10	0.00E+00

INVERSE MATRIX

1.4E-05	1.0E-05	7.3E-06	3.6E-06	9.2E-06	9.2E-06	9.2E-06	8.6E-06	8.6E-06
1.0E-05	1.0E-05	7.3E-06	3.6E-06	9.2E-06	9.2E-06	9.2E-06	8.6E-06	8.6E-06
7.3E-06	7.3E-06	7.3E-06	3.6E-06	7.3E-06	7.3E-06	7.3E-06	7.3E-06	7.3E-06
3.6E-06	3.6E-06	3.6E-06	3.6E-06	3.6E-06	3.6E-06	3.6E-06	3.6E-06	3.6E-06
9.2E-06	9.2E-06	7.3E-06	3.6E-06	2.3E-05	1.9E-05	1.4E-05	1.2E-05	1.2E-05
9.2E-06	9.2E-06	7.3E-06	3.6E-06	1.9E-05	1.9E-05	1.4E-05	1.2E-05	1.2E-05
9.2E-06	9.2E-06	7.3E-06	3.6E-06	1.4E-05	1.4E-05	1.4E-05	1.2E-05	1.2E-05
8.6E-06	8.6E-06	7.3E-06	3.6E-06	1.2E-05	1.2E-05	1.2E-05	1.4E-05	1.4E-05
8.6E-06	8.6E-06	7.3E-06	3.6E-06	1.2E-05	1.2E-05	1.2E-05	1.4E-05	1.8E-05

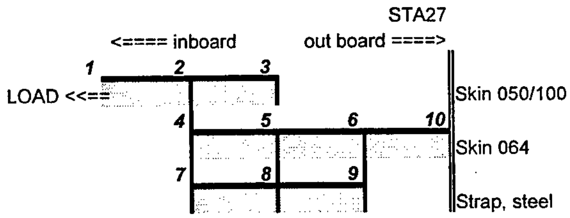
RESULTS



	Stiffness	node #	node #		LOAD Between Nodes
	2.74E+05	1	2	TOP	0.00
	2.74E+05	2	3	TOP	0.52
load between nodes	2.74E+05	3	4	TOP	1.00
load in fastener	2.74E+05	4	10	TOP	1.00
load between nodes	2.19E+05	5	6	BOTT	1.00

A-9 PSE W10 Stiffness Model

PSE W-10 - WING SKIN SPLICE AT STA 27, SA226



FASTENER PROPERTY

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

		Maneuver		
Sprectrum	taxi	1-g	Stress/g	landing
commuter	4615	4615	6769	3300

APPLY LOAD, LANDING

Assume Splice Width	0.04	thk 0.064* width .625 (rivet spacing)
Stress	3300	same as PSE W-3
APPLY LOAD =	132	area of outboard skin

Taxi spectrum = same as 1-g stress
Landing spectrum = apply sa227 gage 21
Maneuver spectrum = Table E-12

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	THK	E	L		D	thk-top	thk-bott	C1,(cont)	C2,(cont)
1.0.E+06	1	2	SKIN 050	0.1000	0.100	1.0E+07	1.00						
5.0.E+05	2	3	SKIN 050	0.0240	0.050	1.0E+07	0.48	** cap, angle, strap K = [A * E] / L					
6.4.E+05	4	5	SKIN 064	0.0307	0.064	1.0E+07	0.48	** fastener E = avg of top and bottom material.					
6.4.E+05	5	6	SKIN 064	0.0474	0.064	1.0E+07	0.74	** fastener K= E*D/ (C1+C2 * [D/ThkTop+D/ThkBott])^2					
6.4.E+05	6	10	SKIN 064	0.1280	0.064	1.0E+07	2.00						
2.1.E+06	7	8	STRAP	0.0341	0.071	3.0E+07	0.48						
2.1.E+06	8	9	STRAP	0.0525	0.071	3.0E+07	0.74						
2.1.E+05	2	4	FSTN	100 Skin + strap		1.0E+07			0.192	0.1	0.064	5	0.8
1.8.E+05	3	5	FSTN	050 Skin + 064Skin		1.0E+07			0.192	0.05	0.064	5	0.8
3.0.E+05	4	7	FSTN	064 Skin + Strap		1.5E+07			0.192	0.064	0.071	5	0.8
3.0.E+05	5	8	FSTN	064 Skin + Strap		1.5E+07			0.192	0.064	0.071	5	0.8
3.0.E+05	6	9	FSTN	064 Skin + Strap		1.5E+07			0.192	0.064	0.071	5	0.8

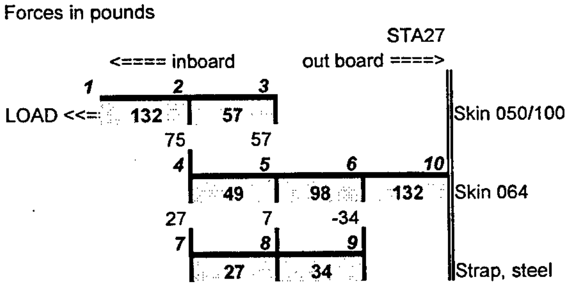
STIFFNESS MATRIX

STIFFNESS MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10		App Load	Displacement
1.0E+06	-1.0E+06	0	0	0	0	0	0	0	0	Node 1	132	9.2E-04
-1.0E+06	1.7E+06	-5.0E+05	-2.1E+05	0	0	0	0	0	0	Node 2	0	7.8E-04
0	-5.0E+05	6.8E+05	0.0E+00	-1.8E+05	0	0	0	0	0	Node 3	0	6.7E-04
0	-2.1E+05	0.0E+00	1.2E+06	-6.4E+05	0	-3.0E+05	0	0	0	Node 4	0	4.4E-04
0	0	-1.8E+05	-6.4E+05	1.8E+06	-6.4E+05	0	-3.0E+05	0	0	Node 5	0	3.6E-04
0	0	0	0	-6.4E+05	1.6E+06	0.0E+00	0	-3.0E+05	-6.4E+05	Node 6	0	2.1E-04
0	0	0	-3.0E+05	0	0.0E+00	2.4E+06	-2.1E+06	0	0	Node 7	0	3.5E-04
0	0	0	0	-3.0E+05	0	-2.1E+06	4.6E+06	-2.1E+06	0	Node 8	0	3.3E-04
0	0	0	0	0	-3.0E+05	0	-2.1E+06	2.4E+06	0.0E+00	Node 9	0	3.2E-04
0	0	0	0	0	-6.4E+05	0	0	0.0E+00	6.4E+05	Node 10	0	-

RESULT, LANDING

Forces in pounds



load = Stiffness * (Displacement Node #1 - Displacement Node #2)

Stiffness,	Node #	Node #		Load Between Nodes
1.0E+06	1	2	SKIN 050	132
5.0E+05	2	3	SKIN 050	57
6.4E+05	4	5	SKIN 064	49
6.4E+05	5	6	SKIN 064	98
6.4E+05	6	10	SKIN 064	132
2.1E+06	7	8	STRAP	27
2.1E+06	8	9	STRAP	34
2.1E+05	2	4	FSTN	75
1.8E+05	3	5	FSTN	57
3.0E+05	4	7	FSTN	27
3.0E+05	5	8	FSTN	7
3.0E+05	6	9	FSTN	-34

A-10 PSE W11 Stress Concentration at Fillet – Roark & NASBEM

Roark 5th Ed., Table 37, Case 5a

D	0.200
h	0.050
r	0.020
h/r	2.500
K1	2.505
K2	-0.346
K3	-1.502
K4	0.342
k	1.999

```
#title
 #line 1: title line 1
 #line 2: title line 2
  THICKNESS CHANGE IN SKIN

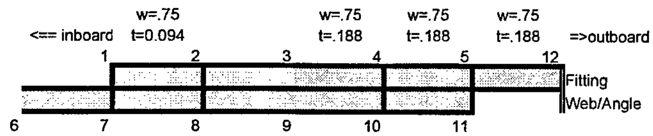
 #units
 #line 1: units index
 #index=1 for US cust units [inch, ksi], 2 for SI units [mm, MPa]
  1
 #points
 #line 1: no of points
 #line n: pnt id no, coords
  16
  1 -0.5000E-01 -0.5200
  2  0.0000     -0.5200
  3  0.5000E-01 -0.5200
  4  0.5000E-01 -0.1000E-01
  5  0.5000E-01  0.5000
  6  0.2500E-01  0.5000
  7  0.0000      0.5000
  8  0.0000      0.2600
  9  0.0000      0.2000E-01
 10  0.0000      0.1000E-01
 11  0.0000      0.0000
 12 -0.2000E-01  0.0000
 13 -0.2000E-01 -0.2000E-01
 14 -0.3500E-01 -0.2000E-01
 15 -0.5000E-01 -0.2000E-01
 16 -0.5000E-01 -0.2700
 #segments
 #line 1: no of segments
 #line n: seg id, type, 1st & mid & 2nd endpt ids, no of elems
  8
  1  0  1  2  3  2
  2  0  3  4  5  8
  3  0  5  6  7  2
  4  0  7  8  9  8
  5  0  9 10 11  2
  6  1 11 12 13  2
  7  0 13 14 15  2
  8  0 15 16  1  2
 #general boundaries
 #line 1: no of boundaries
 #line n: bdry id, no of segs, seg ids, no of edge crks, edge crk ids
  1
  1  8  1  2  3  4  5  6  7  8  0
 #special hole bdries (same id set as gen bdries)
```

A-10 PSE W11 Stress Concentration at Fillet – Roark & NASBEM (Continued)

```
#line 1: no of hole bdries
#line n: bd id, ctrpt id, rad, pressure, pinload mag&angle, # of edge crks&ids
 0
#zone geometry
#line 1: no of zones
#line n: id, mtl id, # of finite bdries&ids, # of crks&ids, # of pt loads&ids
 1
 1  1  1  1  0  0
#boundary conditions, user-specified
#line 1: no of segments with user-specified BC
#line n (1 line per seg pt 1,2,3): seg id, seg pt, x BC type&value, y type&val
 2
 1  1  1  0.0000    1  0.0000
 1  2  1  0.0000    1  0.0000
 1  3  1  0.0000    1  0.0000
 3  1  0  0.0000    0  0.800
 3  2  0  0.0000    0  1.000
 3  3  0  0.0000    0  1.200
#pt loads
#line 1: no of pt loads
#line n: pt load id, location pt id, x & y components
 0
#materials
#line 1: number of materials
#line n: matl id no, e, nu
 1
 1  0.1000E+08  0.3000
#2-D problem type
#line 1: type=1(2), 3(4) plane strain(stress) for finite,infinite ext bdry
#line 2 [only if infinite case]: stress sxx,sxy,syy at infinity; fix pt id no
 2
#crack segments
#line 1: no of segments
#line n: id, type, 1st & arc ctr (or 0) & 2nd endpt ids, no of elems, n&t stress
 0
#cracks
#line 1: crack case [1=spec,2=gen'l], no of cracks
#line n: depends on the crack case
 0  0
```

A-11 PSE W12 Stiffness Models

PSE W12 - SA227 TIP EXTENSION AT END OF INBOARD FITTING



Fasteners = 6203 Bolts

FASTENER PROPERTY		STEEL	ALUM	Titanium
TOP FSTNER	C1=	1.667	5.000	4.000
FSTNER BOTTOM	C2=	0.860	0.800	0.820

MANEUVER EXECUTIVE 1-G STRESS

Stress@ Gage 26	930	
APPLY LOAD =	218	angle, stress * area
Web Angle	0.2344	Angle Area, taper to .75" high

spectrum	taxi	1-g stress	stress/g	landing
commute	-2000	805	1073	500
cargo		834	1111	
executive		930	1239	

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	Thickness	Width	E	L	D	thk-top	thk-bott	C1 (cont)	C2 (cont)
4159500	1	2	FITTING	0.0705	0.094	0.75	3.0E+07	0.5					
4159500	2	3	FITTING	0.0705	0.094	0.75	3.0E+07	0.5					
4159500	3	4	FITTING	0.141	0.188	0.75	3.0E+07	1					
4159500	4	5	FITTING	0.141	0.188	0.75	3.0E+07	1					
4436800	5	12	FITTING	0.1504	0.188	0.8	3.0E+07	1					
2344000	6	7	Web Angle	0.2344			1.0E+07	1					
4688000	7	8	Web Angle	0.2344			1.0E+07	0.5					
4688000	8	9	Web Angle	0.2344			1.0E+07	0.5					
2344000	9	10	Web Angle	0.2344			1.0E+07	1					
2344000	10	11	Web Angle	0.2344			1.0E+07	1					
6184600	1	7	FSTN				1.5E+08		0.19	0.1	0.125	1.667	0.86
6184600	2	8	FSTN				1.5E+08		0.19	0.1	0.125	1.667	0.86
7086700	4	10	FSTN				1.5E+08		0.19	0.156	0.125	1.667	0.86
7086700	5	11	FSTN				1.5E+08		0.19	0.156	0.125	1.667	0.86

** cap, angle, strap K = [A * E] / L

** fastener E = the E average of the top material and the bottom material.

** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

STIFFNESS MATRIX

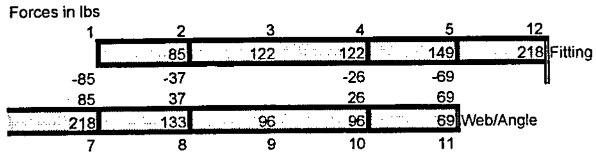
Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	Node 11	Node 12	App Load	Node
1.0E+07	-4.2E+06	0	0	0	0	-6.2E+06	0	0	0	0	0	0	Node 1
-4.2E+06	1.5E+07	-4.2E+06	0	0	0	0	-6.2E+06	0	0	0	0	0	Node 2
0	-4.2E+06	8.3E+06	-4.2E+06	0	0	0	0	0	0	0	0	0	Node 3
0	0	-4.2E+06	1.5E+07	-4.2E+06	0	0	0	0	-7.1E+06	0	0	0	Node 4
0	0	0	-4.2E+06	1.6E+07	0.0E+00	0	0	0	0	-7.1E+06	-4.4E+06	0	Node 5
0	0	0	0	0.0E+00	2.3E+06	-2.3E+06	0	0	0	0		218	Node 6
-6.2E+06	0	0	0	0	-2.3E+06	1.3E+07	-4.7E+06	0	0	0	0	0	Node 7
0	-6.2E+06	0	0	0	0	-4.7E+06	1.6E+07	-4.7E+06	0	0	0	0	Node 8
0	0	0	0	0	0	0	-4.7E+06	7.0E+06	-2.3E+06	0	0	0	Node 9
0	0	0	-7.1E+06	0	0	0	0	-2.3E+06	1.2E+07	-2.3E+06	0	0	Node 10
0	0	0	0.0E+00	-7.1E+06	0	0	0	0	-2.3E+06	9.4E+06	0.0E+00	0	Node 11
0	0	0	0.0E+00	-4.4E+06	0	0	0	0	0	0.0E+00	4.4E+06	0	Node 12

INVERSE MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	Node 11	
8.2E-07	6.7E-07	5.3E-07	3.901E-07	2.254E-07	7.533E-07	7.533E-07	6.69E-07	5.807E-07	4.041E-07	2.698E-07	Node 1
6.7E-07	6.9E-07	5.4E-07	3.914E-07	2.254E-07	6.592E-07	6.592E-07	6.425E-07	5.62E-07	4.01E-07	2.69E-07	Node 2
5.3E-07	5.4E-07	5.9E-07	3.977E-07	2.254E-07	5.242E-07	5.242E-07	5.153E-07	4.723E-07	3.862E-07	2.654E-07	Node 3
3.9E-07	3.9E-07	4.0E-07	4.04E-07	2.254E-07	3.892E-07	3.892E-07	3.881E-07	3.825E-07	3.714E-07	2.617E-07	Node 4
2.3E-07	2.3E-07	2.3E-07	2.254E-07	2.254E-07	2.254E-07	2.254E-07	2.254E-07	2.254E-07	2.254E-07	2.254E-07	Node 5
7.5E-07	6.6E-07	5.2E-07	3.892E-07	2.254E-07	1.243E-06	8.166E-07	6.868E-07	5.932E-07	4.062E-07	2.703E-07	Node 6
7.5E-07	6.6E-07	5.2E-07	3.892E-07	2.254E-07	8.166E-07	8.166E-07	6.868E-07	5.932E-07	4.062E-07	2.703E-07	Node 7
6.7E-07	6.4E-07	5.2E-07	3.9E-07	2.3E-07	6.9E-07	6.9E-07	7.1E-07	6.1E-07	4.089E-07	2.71E-07	Node 8
5.8E-07	5.6E-07	4.7E-07	3.8E-07	2.3E-07	5.9E-07	5.9E-07	6.1E-07	6.9E-07	4.221E-07	2.743E-07	Node 9
4.0E-07	4.0E-07	3.9E-07	3.7E-07	2.3E-07	4.1E-07	4.1E-07	4.1E-07	4.2E-07	4.484E-07	2.808E-07	Node 10
2.7E-07	2.7E-07	2.7E-07	2.6E-07	2.3E-07	2.7E-07	2.7E-07	2.7E-07	2.7E-07	2.808E-07	3.452E-07	Node 11

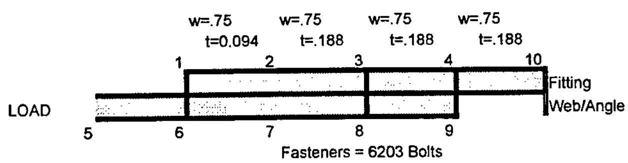
A-11 PSE W12 Stiffness Models (Continued)

RESULT, MANEUVER EXECUTIVE 1-G STRESS CONDITION



Stiffness	node #	node #		LOAD Between Nodes
4.160E+06	1	2	FITTING	85
4.160E+06	2	3	FITTING	122
4.160E+06	3	4	FITTING	122
4.160E+06	4	5	FITTING	149
4.437E+06	5	12	FITTING	218
2.344E+06	6	7	Web Angle	218
4.688E+06	7	8	Web Angle	133
4.688E+06	8	9	Web Angle	96
2.344E+06	9	10	Web Angle	96
2.344E+06	10	11	Web Angle	69
6.185E+06	1	7	FSTN	-85
6.185E+06	2	8	FSTN	-37
7.087E+06	4	10	FSTN	-26
7.087E+06	5	11	FSTN	-69

PSE W12 - SA227 TIP EXTENSION AT END OF INBOARD FITTING



FASTENER PROPERTY				
TOP		STEEL	ALUM	Titanium
FSTNER	C1=	1.667	5.000	4.000
FSTNER	C2=	0.860	0.800	0.820
BOTTOM				

MANEUVER EXECUTIVE 1-G STRESS

Stress@ Gage 26	1073	
APPLY LOAD =	252	angle, stress * area
Web Angle	0.2344	Angle Area, taper to .75" high

spectrum	taxi	1-g stress	stress/g	landing
commute	-2000	805	1073	500
cargo		834	1111	
executive		930	1239	

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	Thickness	Width	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)
4159500	1	2	FITTING	0.0705	0.094	0.75	3.0E+07	0.5					
8319000	2	3	FITTING	0.141	0.188	0.75	3.0E+07	0.5					
4159500	3	4	FITTING	0.141	0.188	0.75	3.0E+07	1					
4436800	4	10	FITTING	0.1504	0.188	0.8	3.0E+07	1					
2344000	5	6	Web Angle	0.2344			1.0E+07	1					
4688000	6	7	Web Angle	0.2344			1.0E+07	0.5					
4688000	7	8	Web Angle	0.2344			1.0E+07	0.5					
2344000	8	9	Web Angle	0.2344			1.0E+07	1					
6184600	1	6	FSTN				1.5E+08		0.19	0.1	0.125	1.667	0.86
7086700	3	8	FSTN				1.5E+08		0.19	0.156	0.125	1.667	0.86
7086700	4	9	FSTN				1.5E+08		0.19	0.156	0.125	1.667	0.86

** cap, angle, strap K = [A * E] / L

** fastener E = the E average of the top material and the bottom material.

** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

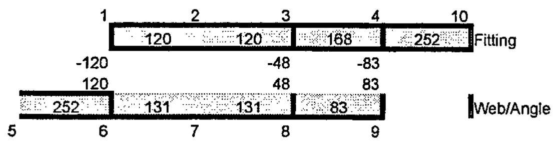
A-11 PSE W12 Stiffness Models (Continued)

STIFFNESS MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	App Load	Node	Displace
1.0E+07	-4.2E+06	0	0	0	-6.2E+06	0	0	0	0	0	Node 1	1.41E-04
-4.2E+06	1.2E+07	-8.3E+06	0	0	0	0	0	0	0	0	Node 2	1.12E-04
0	-8.3E+06	2.0E+07	-4.2E+06	0	0	0	-7.1E+06	0	0	0	Node 3	9.71E-05
0	0	-4.2E+06	1.6E+07	0.0E+00	0	0	0	-7.1E+06	-4.4E+06	0	Node 4	5.67E-05
0	0	0	0.0E+00	2.3E+06	-2.3E+06	0	0	0	0	252	Node 5	2.67E-04
-6.2E+06	0	0	0	-2.3E+06	1.3E+07	-4.7E+06	0	0	0	0	Node 6	1.60E-04
0	0	0	0	0	-4.7E+06	9.4E+06	-4.7E+06	0	0	0	Node 7	1.32E-04
0	0	-7.1E+06	0	0	0	-4.7E+06	1.4E+07	-2.3E+06	0	0	Node 8	1.04E-04
0	0	0	-7.1E+06	0	0	0	-2.3E+06	9.4E+06	0.0E+00	0	Node 9	6.84E-05
0	0	0	-4.4E+06	0	0	0	0	0.0E+00	4.4E+06	0	Node 10	0.00E+00

RESULT, MANEUVER EXECUTIVE 1-G STRESS CONDITION

Forces in lbs



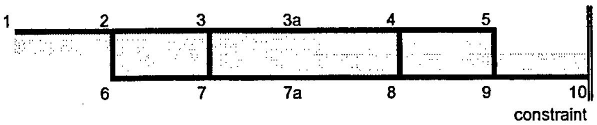
Stiffness	node #	node #		LOAD Between Nodes
4.160E+06	1	2	FITTING	120
8.319E+06	2	3	FITTING	120
4.160E+06	3	4	FITTING	168
4.437E+06	4	10	FITTING	252
2.344E+06	5	6	Web Angle	252
4.688E+06	6	7	Web Angle	131
4.688E+06	7	8	Web Angle	131
2.344E+06	8	9	Web Angle	83
6.185E+06	1	6	FSTN	-120
7.087E+06	3	8	FSTN	-48
7.087E+06	4	9	FSTN	-83

A-12 PSE W13 Stiffness Model

PSE W13 - SA227 TIP EXTENSION AT END OF OUTBOARD FITTING @ 16,500 lbs

Rear Spar Lower Surface, AFT C.G. (R1517 - Page A-87)

LOAD



FASTENER PROPERTY				
TOP		STEEL	ALUM	Titanium
FSTNER	C1=	1.667	5.000	4.000
FSTNER	C2=	0.860	0.800	0.820
BOTTOM				

LANDING

Stress@ Gage 26 500

APPLY LOAD = 53 angle, stress * area

spectrum	taxi	1-g stress	stress/g	landing
commute	-2000	1779	1779	500
cargo		1842	2314	
executive		2054	2580	

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)
2079800	1	2	TOP	0.141	3.0E+07	2					
5546000	2	3	TOP	0.141	3.0E+07	0.75					
11092000	3	3a	TOP	0.141	3.0E+07	0.375					
5585300	3a	4	TOP	0.071	3.0E+07	0.375					
2792700	4	5	TOP	0.071	3.0E+07	0.75					
1400000	6	7	BOTT	0.105	1.0E+07	0.75					
2800000	7	7a	BOTT	0.105	1.0E+07	0.375					
2800000	7a	8	BOTT	0.105	1.0E+07	0.375					
1400000	8	9	BOTT	0.105	1.0E+07	0.75					
525000	9	10	BOTT	0.105	1.0E+07	2					
740800	2	6	FSTN		2.0E+07		0.19	0.188	0.063	1.667	0.86
740800	3	7	FSTN		2.0E+07		0.19	0.188	0.063	1.667	0.86
633400	4	8	FSTN		2.0E+07		0.19	0.094	0.063	1.667	0.86
633400	5	9	FSTN		2.0E+07		0.19	0.094	0.063	1.667	0.86

** cap, angle, strap K = [A * E] / L

** fastener E = the E average of the top material and the bottom material.

** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

STIFFNESS MATRIX

Node 1	Node 2	Node 3	Node 3a	Node 4	Node 5	Node 6	Node 7	Node 7a	Node 8	Node 9	Node 10	App Load
2.08E+06	-2.08E+06	0	0	0	0	0	0	0	0	0	0	52.5
-2.08E+06	8.37E+06	-5.55E+06	0	0	0	-7.41E+05	0	0	0	0	0	0
0	-5.55E+06	1.74E+07	-1.11E+07	0	0	0	-7.41E+05	0	0	0	0	0
0	0	-1.11E+07	16677300	-5.59E+06	0	0	0	0	0	0	0	0
0	0	0	-5.59E+06	9.01E+06	-2.79E+06	0	0	0	-6.33E+05	0	0	0
0	0	0	0	-2.79E+06	3.43E+06	0	0	0	0	-6.33E+05	0	0
0	-7.41E+05	0	0	0	0	2.14E+06	-1.40E+06	0	0	0	0	0
0	0	-7.41E+05	0	0	0	-1.40E+06	4.94E+06	-2.80E+06	0	0	0	0
0	0	0	0	0	0	0	-2.80E+06	5.60E+06	-2.80E+06	0	0	0
0	0	0	0	-6.33E+05	0	0	0	-2.80E+06	4.83E+06	-1.40E+06	0	0
0	0	0	0	0	-6.33E+05	0	0	0	-1.40E+06	2.56E+06	-5.25E+05	0
0	0	0	0	0	0	0	0	0	0	-5.25E+05	5.25E+05	0

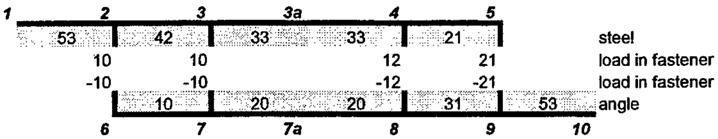
INVERSE MATRIX

Node 1	Node 2	Node 3	Node 3a	Node 4	Node 5	Node 6	Node 7	Node 7a	Node 8	Node 9	
3.477E-06	2.996E-06	2.851E-06	2.794E-06	2.683E-06	2.539E-06	2.738E-06	2.601E-06	2.467E-06	2.332E-06	1.905E-06	Node 1
2.996E-06	2.996E-06	2.851E-06	2.794E-06	2.683E-06	2.539E-06	2.738E-06	2.601E-06	2.467E-06	2.332E-06	1.905E-06	Node 2
2.9E-06	2.9E-06	2.9E-06	2.8E-06	2.7E-06	2.6E-06	2.7E-06	2.6E-06	2.5E-06	2.326E-06	1.905E-06	Node 3
2.8E-06	2.8E-06	2.8E-06	2.8E-06	2.7E-06	2.6E-06	2.6E-06	2.5E-06	2.4E-06	2.317E-06	1.905E-06	Node 3a
2.7E-06	2.7E-06	2.7E-06	2.7E-06	2.8E-06	2.6E-06	2.6E-06	2.5E-06	2.4E-06	2.3E-06	1.905E-06	Node 4
2.5E-06	2.5E-06	2.6E-06	2.6E-06	2.6E-06	2.8E-06	2.4E-06	2.4E-06	2.3E-06	2.227E-06	1.905E-06	Node 5
2.7E-06	2.7E-06	2.7E-06	2.6E-06	2.6E-06	2.4E-06	3.2E-06	2.8E-06	2.6E-06	2.38E-06	1.905E-06	Node 6
2.6E-06	2.6E-06	2.6E-06	2.5E-06	2.5E-06	2.4E-06	2.8E-06	2.9E-06	2.6E-06	2.406E-06	1.905E-06	Node 7
2.5E-06	2.5E-06	2.5E-06	2.4E-06	2.4E-06	2.3E-06	2.6E-06	2.6E-06	2.7E-06	2.439E-06	1.905E-06	Node 7a
2.3E-06	2.3E-06	2.3E-06	2.3E-06	2.3E-06	2.2E-06	2.4E-06	2.4E-06	2.4E-06	2.473E-06	1.905E-06	Node 8
1.9E-06	1.9E-06	1.9E-06	1.9E-06	1.9E-06	1.9E-06	1.9E-06	1.9E-06	1.9E-06	1.905E-06	1.905E-06	Node 9

A-12 PSE W13 Stiffness Model (Continued)

RESULT

Forces in lbs

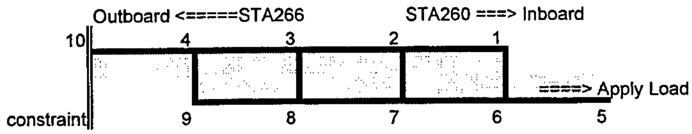


Stiffness	node #	node #		LOAD Between Nodes
2.080E+06	1	2	TOP	53
5.546E+06	2	3	TOP	42
1.109E+07	3	3a	TOP	33
5.585E+06	3a	4	TOP	33
2.793E+06	4	5	TOP	21
1.400E+06	6	7	BOTT	10
2.800E+06	7	7a	BOTT	20
2.800E+06	7a	8	BOTT	20
1.400E+06	8	9	BOTT	31
5.250E+05	9	10	BOTT	53
7.408E+05	2	6	FSTN	10
7.408E+05	3	7	FSTN	10
6.334E+05	4	8	FSTN	12
6.334E+05	5	9	FSTN	21

A-13 PSE W14 Stiffness Model

PSE W14 - SA227 TIP EXTENSION AT END OF OUTBOARD FITTING

Main Spar Lower Surface, AFT C.G. (R1517 - Page A-87)



FASTENER PROPERTY		STEEL	ALUM	Titanium
TOP				
FSTNER	C1=	1.667	5.000	4.000
FSTNER	C2=	0.860	0.800	0.820
BOTTOM				

APPLY LOAD, LANDING

Stress@ Gage 25	800		
APPLY LOAD =	75 angle, stress * area		
		width	thickness
steel fitting	0.1264	0.81	0.156
steel fitting	0.0810	0.81	0.1
angle, v.leg	0.0938	0.75	0.125

spectrum	taxi	1-g stress	stress/g	landing
commute	compressior	805	1073	800
cargo		834	1111	
executive		930	1239	

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)
2096100	1	2	TOP	0.081	3.0E+07	1.14					
2096100	2	3	TOP	0.081	3.0E+07	1.14					
3260500	3	4	TOP	0.126	3.0E+07	1.14					
1858500	4	10	TOP	0.126	3.0E+07	2					
469000	5	6	BOTT	0.094	1.0E+07	2					
822800	6	7	BOTT	0.094	1.0E+07	1.14					
822800	7	8	BOTT	0.094	1.0E+07	1.14					
822800	8	9	BOTT	0.094	1.0E+07	1.14					
7086700	1	6	FSTN		1.5E+08		0.19	0.156	0.125	1.667	0.86
7086700	2	7	FSTN		1.5E+08		0.19	0.156	0.125	1.667	0.86
6184600	3	8	FSTN		1.5E+08		0.19	0.1	0.125	1.667	0.86
6184600	4	9	FSTN		1.5E+08		0.19	0.1	0.125	1.667	0.86

** cap, angle, strap K = [A * E] / L

** fastener E = the E average of the top material and the bottom material.

** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

STIFFNESS MATRIX

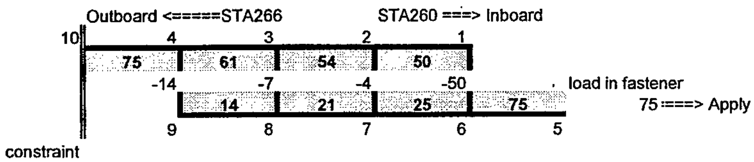
Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	App Load	Node
9.18E+06	-2.10E+06	0	0	0	-7.09E+06	0	0	0	0	0	Node 1
-2.10E+06	1.13E+07	-2.10E+06	0	0	0	-7.09E+06	0	0	0	0	Node 2
0	-2.10E+06	1.15E+07	-3.26E+06	0	0	0	-6.18E+06	0	0	0	Node 3
0	0	-3.26E+06	1.13E+07	0	0	0	0	-6.18E+06	-1.86E+06	0	Node 4
0	0	0	0	4.69E+05	-4.69E+05	0	0	0	0	75	Node 5
-7.09E+06	0	0	0	-4.69E+05	8.38E+06	-8.23E+05	0	0	0	0	Node 6
0	-7.09E+06	0	0	0	-8.23E+05	8.73E+06	-8.23E+05	0	0	0	Node 7
0	0	-6.18E+06	0	0	0	-8.23E+05	7.83E+06	-8.23E+05	0	0	Node 8
0	0	0	-6.18E+06	0	0	0	-8.23E+05	7.01E+06	0	0	Node 9
0	0	0	-1.86E+06	0	0	0	0	0	1.86E+06	0	Node 10

INVERSE MATRIX

1.5E-06	1.1E-06	7.9E-07	5.4E-07	1.4E-06	1.4E-06	1.1E-06	8.0E-07	5.7E-07
1.1E-06	1.1E-06	7.9E-07	5.4E-07	1.1E-06	1.1E-06	1.1E-06	8.0E-07	5.7E-07
7.9E-07	7.9E-07	7.9E-07	5.4E-07	7.9E-07	7.9E-07	7.9E-07	7.7E-07	5.7E-07
5.4E-07	5.4E-07	5.4E-07	5.4E-07	5.4E-07	5.4E-07	5.4E-07	5.4E-07	5.4E-07
1.4E-06	1.1E-06	7.9E-07	5.4E-07	3.7E-06	1.5E-06	1.1E-06	8.0E-07	5.7E-07
1.4E-06	1.1E-06	7.9E-07	5.4E-07	1.5E-06	1.5E-06	1.1E-06	8.0E-07	5.7E-07
1.1E-06	1.1E-06	7.9E-07	5.4E-07	1.1E-06	1.1E-06	1.2E-06	8.1E-07	5.7E-07
8.0E-07	8.0E-07	7.7E-07	5.4E-07	8.0E-07	8.0E-07	8.1E-07	8.8E-07	5.8E-07
5.7E-07	5.7E-07	5.7E-07	5.4E-07	5.7E-07	5.7E-07	5.7E-07	5.8E-07	6.9E-07

A-13 PSE W14 Stiffness Model (Continued)

RESULT, LANDING



Stiffness	node #	node #		LOAD Between Nodes
2.10E+06	1	2	TOP	50
2.10E+06	2	3	TOP	54
3.26E+06	3	4	TOP	61
1.86E+06	4	10	TOP	75
4.69E+05	5	6	BOTT	75
8.23E+05	6	7	BOTT	25
8.23E+05	7	8	BOTT	21
8.23E+05	8	9	BOTT	14
7.09E+06	1	6	FSTN	-50
7.09E+06	2	7	FSTN	-4
6.18E+06	3	8	FSTN	-7
6.18E+06	4	9	FSTN	-14

A-14 Engine Mount Stress Analysis (Continued)

PSE EM1 Upper Engine Mount at Firewall - Pre S/B

Roark 5th Ed, Case 1J, Table 24
Assumes no rotation in weld joint or in plate at washer OD

W=	1.000	(unit line load, lbs)
a=	0.718	(mean radius of tube)
Ro=	0.718	(radius of appl of W)
b=	0.391	(OD of washer/2)
w=	0.444	(applied load per inch)
t=	0.125	(plate thickness)

C5=	0.351895
C6=	0.069786
C8=	0.760711
C9=	0.283638
L5=	0
L6=	0
L8=	1
L9=	0
D=	1813.284

In Plate at Washer OD

Mrb=	-0.11599	in-lb per in per lb
6M/t^2=	-44.5389	psi per lb

In Weld at Tube

Mra=	0.078	in-lb per in per lb
t=	0.205	(thickness of weld)
6M/t^2=	11.08705	psi per lb
P/A=	1.286102	psi per lb
Total=	12.37316	psi per lb

A-14 Engine Mount Stress Analysis (Continued)

PSE EM1 Upper Engine Mount at Firewall - Post S/B

Roark 5th Ed, Case 1J, Table 24
Assumes no rotation in weld joint or in plate at washer OD

W=	1.000	(unit line load, lbs)
a=	0.718	(mean radius of tube)
Ro=	0.718	(radius of appl of W)
b=	0.625	(OD of washer/2)
w=	0.444	(applied load per inch)
t=	0.125	(plate thickness)

C5=	0.12061
C6=	0.007583
C8=	0.917985
C9=	0.115071
L5=	0
L6=	0
L8=	1
L9=	0
D=	1813.284

In Plate at Washer OD

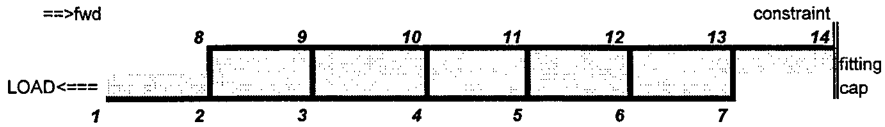
Mrb=	-0.02298	in-lb per in per lb
6M/t^2=	-8.82284	psi per lb

In Weld at Tube

Mra=	0.021	in-lb per in per lb
t=	0.205	(thickness of weld)
6M/t^2=	2.992139	psi per lb
P/A=	1.286102	psi per lb
Total=	4.278241	psi per lb

A-15 PSE N1 Stiffness Model

PSE N1 - SA226/227 Nacelle upper longeron at firewall



	Mat'l	Eff Area
fitting	4130N Steel	0.203
cap	2024-T42	0.10125

FASTENER PROPERTIES

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

APPLIED LOAD

APPLIED LOAD = 1.0

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

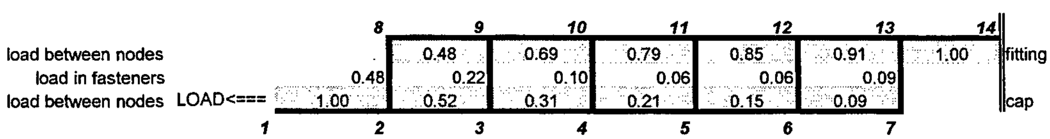
K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)
1346700	1	2	cap	0.101	1.0E+07	0.75					
1346700	2	3	cap	0.101	1.0E+07	0.75					
1346700	3	4	cap	0.101	1.0E+07	0.75					
1346700	4	5	cap	0.101	1.0E+07	0.75					
1346700	5	6	cap	0.101	1.0E+07	0.75					
1346700	6	7	cap	0.101	1.0E+07	0.75					
8120000	8	9	fitting	0.203	3.0E+07	0.75					
8120000	9	10	fitting	0.203	3.0E+07	0.75					
8120000	10	11	fitting	0.203	3.0E+07	0.75					
8120000	11	12	fitting	0.203	3.0E+07	0.75					
8120000	12	13	fitting	0.203	3.0E+07	0.75					
8120000	13	14	fitting	0.203	3.0E+07	0.75					
790400	2	8	FSTN		2.0E+07		0.19	0.125	0.09	1.667	0.86
790400	3	9	FSTN		2.0E+07		0.19	0.125	0.09	1.667	0.86
790400	4	10	FSTN		2.0E+07		0.19	0.125	0.09	1.667	0.86
790400	5	11	FSTN		2.0E+07		0.19	0.125	0.09	1.667	0.86
790400	6	12	FSTN		2.0E+07		0.19	0.125	0.09	1.667	0.86
790400	7	13	FSTN		2.0E+07		0.19	0.125	0.09	1.667	0.86

** stringer,angle K = [A * E] / L

** fastener E = average of the top material E and the bottom material E.

** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

RESULTS



A-16 PSE N2 NASTRAN Output for Fasteners

PSE N2 - SA226/227 Nacelle upper longeron wing rib attach angles

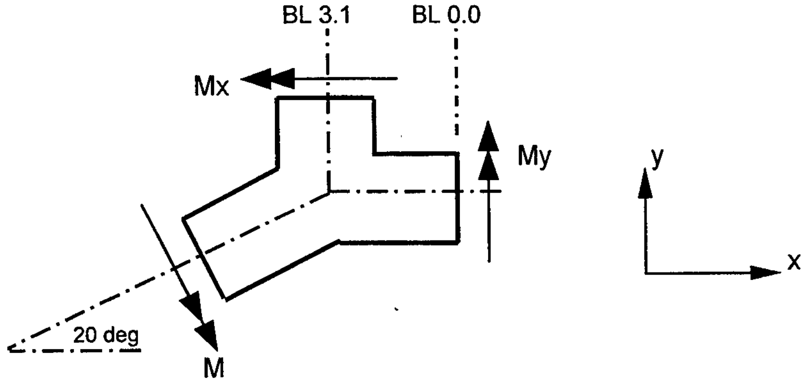
node		component	direction	
	221	-0.063	z (up-down)	
	222	-0.095	z (up-down)	
	223	-0.132	z (up-down)	
	224	-0.205	z (up-down)	
	225	-0.312	z (up-down)	
total		-0.807	cos20=	0.939693
	226	-0.299	y (fwd-aft)	
	227	-0.242	y (fwd-aft)	
	228	-0.043	y (fwd-aft)	
	229	-0.454	y (fwd-aft)	
	230	0.744	y (fwd-aft)	
total		-0.294	sin20=	0.34202

resultant fastener forces listed from aft to forward

221-226	0.3055651	
222-227	0.2599788	
223-228	0.1388272	
224-229	0.4981375	
225-230	0.8067713	fwd fasteners carry more of load since angle is blocked from rotating on fwd side

225-230	224-229	223-228	222-227	221-226
	fwd	<======>	aft	

A-17 PSE H1 Stress Analysis and Stiffness Model



Rib Strap at BL 3.135

Assuming spar cannot carry any moment about z-axis at BL 0.0,
Mx = M sin(20)

Horiz Stab Rear Spar Stress, Aft CG, Gage 14 (BL 15 lower position):

0G	1G	2G	Per G	
-351	375	1554	1179	measured values

At gage, c= 2.25

At BL 15, Moment of Inertia I = 9.9 (ref 27-43000, 27-43077 2601-R155)

Moments

0G	1G	2G	Per G
-1544	1650	6838	5188

Quadratic Interpolation (assumes linear shear dist along spar):

y=b(x-a)^2
a=86.3 (stab tip)
b=(moment@BL15)/(15-86.3)^2

x	a	b 0G	b 1G	b 2G	M 0G	M 1G	M 2G	Per G
0	86.3	-0.304	0.325	1.345	-2262	2417	10018	7601
1	86.3	-0.304	0.325	1.345	-2210	2362	9787	7425
2	86.3	-0.304	0.325	1.345	-2158	2307	9559	7252
3	86.3	-0.304	0.325	1.345	-2107	2252	9333	7081
4	86.3	-0.304	0.325	1.345	-2057	2198	9111	6912
5	86.3	-0.304	0.325	1.345	-2007	2145	8891	6745
6	86.3	-0.304	0.325	1.345	-1958	2093	8673	6580
7	86.3	-0.304	0.325	1.345	-1910	2041	8459	6418
8	86.3	-0.304	0.325	1.345	-1862	1990	8247	6257
9	86.3	-0.304	0.325	1.345	-1815	1939	8037	6098
10	86.3	-0.304	0.325	1.345	-1768	1890	7831	5941
11	86.3	-0.304	0.325	1.345	-1722	1840	7627	5786
12	86.3	-0.304	0.325	1.345	-1677	1792	7426	5634
13	86.3	-0.304	0.325	1.345	-1632	1744	7227	5483
14	86.3	-0.304	0.325	1.345	-1588	1697	7031	5335
15	86.3	-0.304	0.325	1.345	-1544	1650	6838	5188

Horiz Stab Rear Spar Splice Strap Stress, Fwd of Splice Plate:

0G	1G	2G	Per G	
-686	733	3039	2305	calculated values

Shows stress in strap is about twice measured spar stress

At strap, c= 3.0

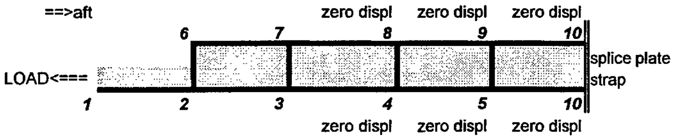
Fwd of splice plate, I= 3.15 neglecting effect of trunnion fitting 27-43047 (ref 27-43000, 27-43077, 2601-R155)

Moment In Splice Strap, Fwd of splice plate
=Spar moment * SIN(sweep ang)

M 0G	M 1G	M 2G	Per G
-720	770	3191	2421

A-17 PSE H1 Stress Analysis and Stiffness Model (Continued)

PSE H1 - SA226/227 Horizontal stabilizer station 3.135 rib strap at rear spar



	Matl	Eff Area	
splice plate	2024-T3	see right	(27-43077)
strap	2024-T3	0.125	(27-43077)

FASTENER PROPERTIES

	STEEL	ALUM	Titanium
C1=	1.667	5.000	4.000
C2=	0.860	0.800	0.820

Fasteners NAS1203-6 screws
(ref 27-43000)

Effective Plate Area

Btwn 1st-2nd	0.09375
Btwn 2nd-3rd	0.1875

APPLIED LOAD

APPLIED LOAD = 1.0

ELEMENT STIFFNESS

Assuming Plane Sections Remain Plane

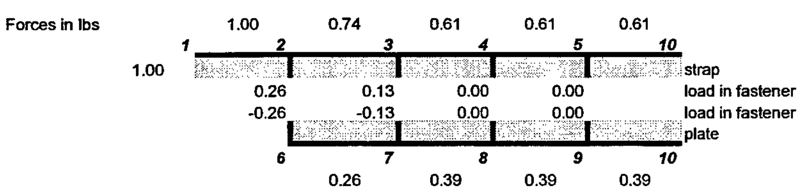
K	K11	K22		A	E	L	D	thk-top	thk-bott	C1,(cont)	C2,(cont)
1250000	1	2	strap	0.125	1.0E+07	1					
1250000	2	3	strap	0.125	1.0E+07	1					
1250000	3	4	strap	0.125	1.0E+07	1					
9.999E+13	4	5	strap	9999	1.0E+07	0.001					
9.999E+13	5	10	strap	9999	1.0E+07	0.001					
940000	6	7	plate	0.094	1.0E+07	1					
1875000	7	8	plate	0.1875	1.0E+07	1					
9.999E+13	8	9	plate	9999	1.0E+07	0.001					
9.999E+13	9	10	plate	9999	1.0E+07	0.001					
441900	2	6	FSTN		1.0E+07		0.19	0.125	0.125	1.667	0.86
441900	3	7	FSTN		1.0E+07		0.19	0.125	0.125	1.667	0.86
2.952E+10	4	8	FSTN		1.0E+07		9999.00	9999	9999	1.667	0.86
2.952E+10	5	9	FSTN		1.0E+07		9999.00	9999	9999	1.667	0.86

** stringer,angle K = [A * E] / L
** fastener E = average of the top material E and the bottom material E.
** fastener K = [E * D / (C1 + C2 * [D / ThkTop + D / ThkBott])] ^2

STIFFNESS MATRIX

Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	App Load	Node	Displacement
1.3E+06	-1.3E+06	0	0	0	0	0	0	0	0	1	Node 1	1.880E-06
-1.3E+06	2.9E+06	-1.3E+06	0	0	-4.4E+05	0	0	0	0	0	Node 2	1.080E-06
0	-1.3E+06	2.9E+06	-1.3E+06	0	0	-4.4E+05	0	0	0	0	Node 3	4.899E-07
0	0	-1.3E+06	1.0E+14	-1.0E+14	0	0	-3.0E+10	0	0	0	Node 4	1.225E-14
0	0	0	-1.0E+14	2.0E+14	0	0	0	-3.0E+10	-1.0E+14	0	Node 5	6.122E-15
0	-4.4E+05	0	0	0	1.4E+06	-9.4E+05	0	0	0	0	Node 6	4.860E-07
0	0	-4.4E+05	0	0	-9.4E+05	3.3E+06	-1.9E+06	0	0	0	Node 7	2.067E-07
0	0	0	-3.0E+10	0	0	-1.9E+06	1.0E+14	-1.0E+14	0	0	Node 8	7.756E-15
0	0	0	0	-3.0E+10	0	0	-1.0E+14	2.0E+14	-1.0E+14	0	Node 9	3.879E-15
0	0	0	0	-1.0E+14	0	0	0	-1.0E+14	2.0E+14	0	Node 10	0.000E+00

RESULTS



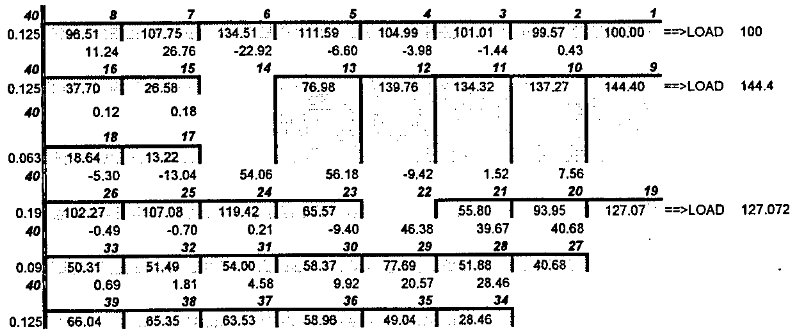
Stiffness	Node #	Node #		Load Between Nodes
1.250E+06	1	2	strap	1.00
1.250E+06	2	3	strap	0.74

DISPLACEMENT

1.9E-06	1.1E-06	4.9E-07	1.2E-14	6.1E-15	0.0E+00

A-18 PSE V1 Stiffness Model Results

RESULTS



(bearing stress is not divided by two even though there are two rows of fasteners)

Stiffness	node #	node #		Load Between Nodes	Area	Stress	node #	Bearing Load	Bearing Area	Bearing Stress	Total Stress	
2.333E+06	1	2	Spar	100.00	0.175	571						
2.333E+06	2	3	Spar	99.57	0.175	569	2	0.43	0.0195	22	591	
2.333E+06	3	4	Spar	101.01	0.175	577	3	1.44	0.0195	74	643	
2.333E+06	4	5	Spar	104.99	0.175	600	4	3.98	0.0195	204	781	
1.750E+06	5	6	Spar	111.59	0.175	638	5	6.60	0.0195	338	938	
1.750E+06	6	7	Spar	134.51	0.175	769	6	22.92	0.0195	1176	1813	
2.333E+06	7	8	Spar	107.75	0.175	616	7	26.76	0.0195	1372	1988	
2.333E+06	8	40	Spar	96.51	0.175	552	8	11.24	0.0195	576	1128	
3.547E+06	9	10	Channel	144.40	0.266	543	10	7.13	0.02964	241	757	
3.547E+06	10	11	Channel	137.27	0.266	516	11	2.96	0.02964	100	616	
3.547E+06	11	12	Channel	134.32	0.266	505	12	5.44	0.02964	184	689	
3.547E+06	12	13	Channel	139.76	0.266	525	13	62.78	0.02964	2118	2407	
2.660E+06	13	14	Channel	76.98	0.266	289	14	76.98	0.02964	2597	2597	worst case matl and load
2.333E+06	15	16	.125 Strap	26.58	0.175	152	15	26.58	0.0195	1363	1363	
2.333E+06	16	40	.125 Strap	37.70	0.175	215	16	11.12	0.0195	570	722	
1.176E+06	17	18	.063 Strap	13.22	0.0882	150	17	13.22	0.009828	1345	1345	
1.176E+06	18	40	.063 Strap	18.64	0.0882	211	18	5.42	0.009828	552	702	
3.547E+06	19	20	Angle	127.07	0.266	478	20	33.12	0.02964	1117	1471	
3.547E+06	20	21	Angle	93.95	0.266	353	21	38.15	0.02964	1287	1497	
3.547E+06	21	22	Angle	55.80	0.266	210	22	55.80	0.02964	1883	1883	
2.660E+06	23	24	.190 Strap	65.57	0.266	247	23	65.57	0.02964	2212	2212	
2.660E+06	24	25	.190 Strap	119.42	0.266	449	24	53.85	0.02964	1817	2063	
3.547E+06	25	26	.190 Strap	107.08	0.266	403	25	12.35	0.02964	417	819	
3.547E+06	26	40	.190 Strap	102.27	0.266	384	26	4.81	0.02964	162	547	
1.680E+06	27	28	.090 Strap	40.68	0.126	323	27	40.68	0.01404	2897	2897	worst case load
1.680E+06	28	29	.090 Strap	51.88	0.126	412	28	11.20	0.01404	798	1121	
1.680E+06	29	30	.090 Strap	77.69	0.126	617	29	25.81	0.01404	1838	2250	
1.260E+06	30	31	.090 Strap	58.37	0.126	463	30	19.31	0.01404	1376	1839	
1.260E+06	31	32	.090 Strap	54.00	0.126	429	31	4.37	0.01404	311	740	
1.680E+06	32	33	.090 Strap	51.49	0.126	409	32	2.51	0.01404	179	587	
1.680E+06	33	40	.090 Strap	50.31	0.126	399	33	1.19	0.01404	84	484	
2.333E+06	34	35	.125 Splice	28.46	0.175	163	34	28.46	0.0195	1460	1460	
2.333E+06	35	36	.125 Splice	49.04	0.175	280	35	20.57	0.0195	1055	1218	
1.750E+06	36	37	.125 Splice	58.96	0.175	337	36	9.92	0.0195	509	789	
1.750E+06	37	38	.125 Splice	63.53	0.175	363	37	4.58	0.0195	235	572	
2.333E+06	38	39	.125 Splice	65.35	0.175	373	38	1.81	0.0195	93	456	
2.333E+06	39	40	.125 Splice	66.04	0.175	377	39	0.69	0.0195	36	409	
4.688E+05	2	10	FSTN	0.43								
4.688E+05	3	11	FSTN	-1.44								
4.688E+05	4	12	FSTN	-3.98								
4.688E+05	5	13	FSTN	-6.60								
4.688E+05	6	14	FSTN	-22.92								
4.460E+05	7	15	FSTN	26.76								
4.460E+05	8	16	FSTN	11.24								
3.910E+05	15	17	FSTN	0.18								

A-19 PSE F-7 Stress Concentration in Cargo Door Hinge

Roark 5th Ed., Table 37, Case 5a

D	1.000
h	0.250
r	0.031
h/r	8.065
K1	3.540
K2	-0.598
K3	0.006
K4	-1.949
k	2.999

A-20 PSE F13 Stress Concentration in Control Column Pin

Roark 5th Ed., Table 37, Case 17b

D	0.625
h	0.062
r	0.020
h/r	3.100
K1	2.657
K2	-2.900
K3	1.535
K4	-0.290
k	2.140

APPENDIX B NASGRO STRESS FACTORS AND CONSTANTS

B-1 PSE W1 SA226 Main Spar Lower Cap at WS 99

INPUT DATA FOR THE NASFLA PROGRAM - ANGLE

Angle, area	w x t =	0.090 (see FEA)	
Angle, flange thick	t=	0.125	
Fastener	D=	0.16	BB5 rivets
Fastener	ED=	0.31	

	TAXI	1-g stress	stress/g	LANDING
stress analytical	-1000	5,497	6,111	4,600
load, stress*area	-90	495	550	414
1st Pin Load	-32	173	192	145
Between Fasteners	-57	312	346	261
Applied Load	-88	485	539	406
PSI				
S0+P/WT	-980	5387	5989	4508
S0 = between fstn	-630	3463	3850	2898
S3 = P/DT	-1575	8658	9625	7245
KSI				
S0+P/WT	-0.98	5.39	5.99	4.51
S0 = between fstn	-0.63	3.46	3.85	2.90
S3 = P/DT	-1.58	8.66	9.62	7.25
constant value, s0		0.90		
constant value, s3		0.90		

INPUT DATA FOR THE NASFLA PROGRAM - CAP

Cap, area	w x t =	0.090 (see FEA)	
Cap, thick	t=	0.125	
Fastener	D=	0.16	BB5 rivets
Fastener	ED=	0.31	

	TAXI	1-g stress	stress/g	LANDING
stress analytical	-1000	5,497	6,111	4,600
load, stress*area	-90	495	550	414
1st Pin Load	-22	119	132	99
Between Fasteners	-68	376	418	315
Applied Load	-90	495	550	414
PSI				
S0+P/WT	-1000	5497	6111	4600
S0 = between fstn	-760	4178	4644	3496
S3 = P/DT	-1080	5937	6600	4968
KSI				
S0+P/WT	-1.00	5.50	6.11	4.60
S0 = between fstn	-0.76	4.18	4.64	3.50
S3 = P/DT	-1.08	5.94	6.60	4.97
constant value, s0		0.90		
constant value, s3		0.90		

PSE W1 Additional Area - Angle

cracked element	x-dim	y-dim	Iyy	Ixx
angle, l,h	1.44	0.125	0.03110	0.00023

additional elements					area	x dist	y dist	A*xd	A*yd	Area*xd_cg^2	Area*yd_cg^2
angle,l,v & 1/2 web	0.15	1.250	0.00035	0.02441	0.1875	0.0625	0.7500	0.01172	0.14063	0.01023	0.03899
angle, r,v & 1/2 web	0.15	1.250	0.00035	0.02441	0.1875	-0.1125	0.7500	-0.02109	0.14063	0.00064	0.03899
angle, r,h	1.44	0.125	0.03110	0.00023	0.1800	-0.7700	0.0625	-0.13860	0.01125	0.06456	0.00964
cap	2.903	0.125	0.25484	0.00047	0.3629	-0.0250	-0.0625	-0.00907	-0.02268	0.00775	0.04611
TOTAL			0.28665	0.04953	0.917875			-0.15705	0.26982	0.08318	0.13374

centc11, G3	cg x-coord	-0.171	sum (a*d) / sum (area)
F3	cg y-coord	0.294	sum (a*d) / sum (area)
intc11, RIY	total Iy	0.370	
RIX	total Ix	0.183	

PSE W1 Additional Area - Cap

cracked element	x-dim	y-dim	Iyy	Ixx
cap	2.903	0.125	0.25484	0.00047

additional elements					area	x dist	y dist	A*xd	A*yd	Area*xd_cg^2	Area*yd_cg^2
angle,l,v & 1/2 web	0.15	1.250	0.00035	0.02441	0.1875	1.5265	0.8750	0.28622	0.16406	0.00105	0.02126
angle, r,v & 1/2 web	0.15	1.250	0.00035	0.02441	0.1875	1.3765	0.8750	0.25809	0.16406	0.00105	0.02126
angle, r,h	1.44	0.125	0.03110	0.00023	0.1800	0.7200	0.1875	0.12960	0.03375	0.09632	0.02215
angle, l,h	1.44	0.125	0.03110	0.00023	0.1800	2.1830	0.1875	0.39294	0.03375	0.09632	0.02215
TOTAL			0.06291	0.04930	0.735			1.06685	0.39563	0.19474	0.08681

centc11, G3	cg x-coord	1.452	sum (a*d) / sum (area)
F3	cg y-coord	0.538	sum (a*d) / sum (area)
intc11, RIY	total Iy	0.258	
RIX	total Ix	0.136	

B-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

PSE W1 - MAIN SPAR, LOWER CAP AT WING STATION 99.00 FOR SA226

INPUT DATA FOR THE NASFLA PROGRAM - CAP

Cap, area	w x t =	0.090	(see FEA)
Cap, thick	t=	0.125	
Fastener	D=	0.16	BB5 rivets
Fastener	ED=	0.31	

	TAXI	1-g stress	stress/g	LANDING
stress analytical	-1000	5,497	6,111	4,600
stress w/ angle cracked	-1000	8,246	9,167	6,900
load, stress*area	-90	742	825	621
1st Pin Load	-37	304	338	255
Between Fasteners	-53	438	487	366
Applied Load	-90	742	825	621
PSI				
S0+P/WT	-1000	8246	9167	6900
S0 = between fstn	-590	4865	5408	4071
S3 = P/DT	-1845	15213	16912	12731
KSI				
S0+P/WT	-1.00	8.25	9.17	6.90
S0 = between fstn	-0.59	4.86	5.41	4.07
S3 = P/DT	-1.85	15.21	16.91	12.73
constant value, s0		0.90		
constant value, s3		0.90		

B-2 PSE W2 SA226 Main Spar Lower Cap at WS 9.0

NASFLA PROGRAM INPUT DATA FOR ALUM SPAR CAP

Cap, 2014-T6511	t=	0.125
Cap, 2014-T6511	W=	3.50
Fastener Dia	D=	0.20
Edge Dist	B=	0.61

	TAXI	1-g stress GUST	stress/g GUST	LANDING	
stress, measured	6580	4,399	6,580	3,300	Gage 2029 (gust) and 21 (landing)
c/l ratio	1.14	1.14	1.14	1.14	From WS 9 to gage 2029 at WS 13
adjusted stress	7501	5015	7501	3762	
PSI					
S0	7501	5015	7501	3762	
KSI					
S0	7.50	5.01	7.50	3.76	
constant value, s0		0.67		0.00	

PSE W2 Additonal Area- Cap

cracked element	x-dim	y-dim	Iyy	Ixx							
cap	3.55	0.125	0.46603	0.00058							
additional elements					Al area	x-dist	y-dist	A*xd	A*yd	Area*xd_cg^2	Area*yd_cg^2
Al angle, r,h	1.75	0.125	0.05583	0.00028	0.2188	0.88	0.19	0.19141	0.04102	0.17719	0.02771
Al angle, l,h	1.75	0.125	0.05583	0.00028	0.2188	2.68	0.19	0.58516	0.04102	0.17719	0.02771
Ti straps, l	1.25	0.250	0.04069	0.00163	0.5000	0.63	0.38	0.31250	0.18750	0.66125	0.01418
Ti straps, r	1.25	0.250	0.04069	0.00163	0.5000	2.93	0.38	1.46250	0.18750	0.66125	0.01418
St angle, l, h	1	0.125	0.01042	0.00016	0.3750	0.75	0.56	0.28125	0.21094	0.39398	0.00014
St angle, r, h	1	0.125	0.01042	0.00016	0.3750	2.80	0.56	1.05000	0.21094	0.39398	0.00014
St straps, l	1	0.250	0.02083	0.00130	0.7500	1.00	0.75	0.75000	0.56250	0.45047	0.03200
St straps, r	1	0.250	0.02083	0.00130	0.7500	2.55	0.75	1.91250	0.56250	0.45047	0.03200
TOTAL			0.25553	0.00675	3.6875			6.54531	2.00391	3.36578	0.14807

centc11, G3	cg x-coord	1.775	sum (a*d) / sum (area)
F3	cg y-coord	0.543	sum (a*d) / sum (area)
intc11, RIY	total Iy	3.621	
RIX	total Ix	0.155	

B-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27

NASFLA PROGRAM INPUT DATA FOR ALUM ANGLE

EXCEL STIFFNESS MODEL					
Spar Cap Angles	Area =	0.15625	horiz leg portion only		
Spar Cap Angles	Area =	0.2976	total		
Angle, flange thickness	t=	0.125			
Fastener	D=	0.25	1st fastener		
Fastener	ED=	0.61	1st fastener		
	TAXI	1-g stress	GUST stress/g	LANDING	
stress, measured	6447	4,396	6,447	2,100	
load, stress*area	1007	687	1007	328	
1st Pin Load	413	282	413	135	41% appl load
Between Fasteners	594	405	594	194	59% appl load
PSI					
S0+P/WT	6447	4396	6447	2100	
S0 = between fstn	3804	2593	3804	1239	
S3 = P/DT	13216	9011	13216	4305	
KSI					
S0+P/WT	6.45	4.40	6.45	2.10	
S0 = between fstn	3.80	2.59	3.80	1.24	
S3 = P/DT	13.22	9.01	13.22	4.31	
constant value, s0		0.68			
constant value, s3		0.68			

B-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

NASTRAN PLATE MODEL						
Spar Cap Angle	Area =	0.15625	horiz leg portion only			
Spar Cap Angle	Area =	0.2976	total			
Spar Cap Angle	t=	0.125				
Fastener	D=	0.25	1st fastener			
Fastener	ED=	0.61	1st fastener			
			GUST			
	TAXI	1-g stress	stress/g	LANDING		
stress, measured	6447	4,396	6,447	2,100		
load, stress*area	1007	687	1007	328		
1st Pin Load	191	130	191	62	19% appl load	
Between Fasteners	816	556	816	266	81% appl load	
PSI						
S0+P/WT	6446	4395	6446	2100		
S0 = between fstn	5222	3560	5222	1701		
S3 = P/DT	6119	4172	6119	1993		
KSI						
S0+P/WT	6.45	4.39	6.45	2.10		
S0 = between fstn	5.22	3.56	5.22	1.70		
S3 = P/DT	6.12	4.17	6.12	1.99		
constant value, s0		0.68				
constant value, s3		0.68				

PSE W3 Additonal Area - Angle

cracked element	x-dim	y-dim	Iyy	Ixx	Al area	x-dist	y-dist	A*xd	A*yd	Area*xd_cg^2	Area*yd_cg^2
Al angle, r, h	1.25	0.125	0.02035	0.00020							
additional elements					Al area	x-dist	y-dist	A*xd	A*yd	Area*xd_cg^2	Area*yd_cg^2
Al angle, l,h	1.25	0.125	0.02035	0.00020	0.1563	-0.68	0.06	-0.10547	0.00977	0.00375	0.01947
Al angle, r,v	0.125	1.100	0.00018	0.01386	0.1375	0.06	0.68	0.00859	0.09281	0.04667	0.00926
Al angle, l,v	0.125	1.100	0.00018	0.01386	0.1375	-0.11	0.68	-0.01547	0.09281	0.02285	0.00926
Ti straps, l	1	0.250	0.02083	0.00130	0.4000	-0.80	0.38	-0.32000	0.15000	0.03133	0.00066
	TOTAL		0.04154	0.02923	0.83125			-0.43234	0.34539	0.10460	0.03864

centc11, G3	cg x-coord	-0.520	sum (a*d) / sum (area)
F3	cg y-coord	0.416	sum (a*d) / sum (area)
intc11, RIY	total Iy	0.146	
RIX	total Ix	0.068	

B-4 PSE W4 SA227 Main Spar Lower Cap at WS 99

PSE W4 - MAIN SPAR, LOWER CAP AT WING STATION 99.00 FOR SA227

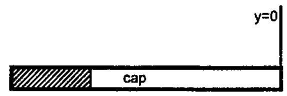
INPUT DATA FOR THE NASFLA PROGRAM - CAP WS99

cap, width	w =	3.00
cap, thickness	t=	0.125
Fastener	D=	0.190
Fastener edge dist	ED=	0.31

Through Crack in Hole

	TAXI	1-g stress Gust, exec	stress/g Gust, exec	1-g stress Gust, cargo	stress/g Gust, cargo	1-g stress Gust, comm	stress/g Gust, comm	LANDING
stress analytical	-1000	7965	7304	7449	6830	7523	6898	4600
KSI								
S0 = between fstn	-1.00	7.97	7.30	7.45	6.83	7.52	6.90	4.60
constant value, s0		1.09		1.09		1.09		

PSE W4 Additonal Area- Cap



cracked element	x-dim	y-dim	Iyy	Ixx
cap	3	0.125	0.28125	0.00049

additional elements	x-dim	y-dim	Iyy	Ixx	Al area	x-dist	y-dist	A*xd	A*yd	Area*xd_cg^2	Area*yd_cg^2
Al angle, r,h	1.44	0.125	0.03110	0.00023	0.1800	0.72	0.19	0.12960	0.03375	0.10951	0.01042
Al angle, l,h	1.44	0.125	0.03110	0.00023	0.1800	2.28	0.19	0.41040	0.03375	0.10951	0.01042
Al angle, r,v	0.125	1.250	0.00020	0.02035	0.1563	1.38	0.88	0.21523	0.13672	0.00234	0.03121
Al angle, l,v	0.125	1.250	0.00020	0.02035	0.1563	1.62	0.88	0.25352	0.13672	0.00234	0.03121
Ti straps, r	1.25	0.250	0.04069	0.00163	0.5000	0.63	0.38	0.31250	0.18750	0.38281	0.00141
Ti straps, l	1.25	0.250	0.04069	0.00163	0.5000	2.38	0.38	1.18750	0.18750	0.38281	0.00141
TOTAL			0.14400	0.04441	1.6725			2.50875	0.71594	0.98934	0.08607

centc11, G3	cg x-coord	1.500	sum (a*d) / sum (area)
F3	cg y-coord	0.428	sum (a*d) / sum (area)
intc11, RIY	total Iy	1.133	
RIX	total Ix	0.130	

INPUT DATA FOR THE NASFLA PROGRAM - ANGLE WS 130

Angle	w x t =	0.09	width (for one fastener in row) x thickness
Angle, flange thickness	t=	0.125	
Fastener	D=	0.190	

	TAXI	1-g stress gust, exec	stress/g gust, exec	1-g stress gust, cargo	stress/g gust, cargo	1-g stress gust, comm	stress/g gust, comm	LANDING
stress analytical WS130	-1000	6612	6415	6184	5999	6245	6059	3818
load applied to angle	-90	595	577	557	540	562	545	344
cap, 1st Pin Load	-9	60	58	56	54	56	55	34
PSI								
S0 = between fstn	-880	5819	5645	5441	5279	5495	5332	3360
S3 = P/DT	-379	2506	2431	2343	2273	2366	2296	1447
KSI								
S0 = between fstn	-0.88	5.82	5.65	5.44	5.28	5.50	5.33	3.36
S3 = P/DT	-0.38	2.51	2.43	2.34	2.27	2.37	2.30	1.45
constant value, s0		1.03		1.03		1.03		
constant value, s3		1.03		1.03		1.03		

B-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

INPUT DATA FOR THE NASFLA PROGRAM - ANGLE WS 146

Angle	w x t =	0.09	width (for one fastener in row) x thickness
Angle, flange thickness	t=	0.125	
Fastener	D=	0.190	

	TAXI	1-g stress gust, exec	stress/g gust, exec	1-g stress gust, cargo	stress/g gust, cargo	1-g stress gust, comm	stress/g gust, comm	LANDING
stress analytical WS146	-1000	5831	5831	5453	5453	5507	5507	3367
load applied to angle	-90	525	525	491	491	496	496	303
cap, 1st Pin Load	-18	105	105	98	98	99	99	61
PSI								
S0 = between fstn	-800	4665	4665	4362	4362	4406	4406	2694
S3 = P/DT	-758	4419	4419	4133	4133	4174	4174	2552
KSI								
S0 = between fstn	-0.80	4.66	4.66	4.36	4.36	4.41	4.41	2.69
S3 = P/DT	-0.76	4.42	4.42	4.13	4.13	4.17	4.17	2.55
constant value, s0		1.00		1.00		1.00		
constant value, s3		1.00		1.00		1.00		

B-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface

PSE W-5 - WING SKIN SPLICE AT WS99, SA227 Inboard — Date: 1-Sep-98

NASFLA PROGRAM INPUT DATA

Through Crack Case 5 ... (row of fasteners)

skin	Area =	0.050	2024-T3 skin .063 t x .800 w
skin thickness	t=	0.063	
Fastener	D=	0.156	
E/D	b/d=	0.000	for .063 skin

		Maneuver, Commuter		Maneuver, Cargo		Maneuver, Executive		
	TAXI	1-g stress	stress/g	1-g stress	stress/g	1-g stress	stress/g	LANDING
stress, measured	-	7523	6898	7449	6830	7965	7304	4600
applied load=stress*area		379	348	375	344	401	368	232
axial load	-	231	212	229	210	245	225	141
1st Pin Load	-	148	136	146	134	157	144	90
PSI								
S0 = axial load	0	4589	4208	4544	4166	4859	4455	2806
S3 = P/DT	0	15046	13796	14898	13660	15930	14608	9200
KSI								
S0 = between fstn	0.00	4.60	4.20	4.50	4.20	4.90	4.50	2.80
S3 = P/DT	0.00	15.00	13.80	14.90	13.70	15.90	14.60	9.20
constant value, s0		1.10		1.07		1.09		
constant value, s3		1.09		1.09		1.09		

PSE W-5 - WING SKIN SPLICE AT WS99, SA227 Outboard — Date: 17-Sep-97, 19-Sep-97, 22-Sep-97, 2-Sep-98

NASFLA PROGRAM INPUT DATA

Through Crack Case 5 ... (row of fasteners)

skin	Area =	0.026	skin of .032 x .800 w (avg), 2024-T3
skin thickness	t=	0.032	
Fastener	D=	0.130	
E/D	b/d=	0.289	b =.45, for shim,
E/D	b/d=	0.000	for .032 skin

		Maneuver, Commuter		Maneuver, Cargo		Maneuver, Executive		
	TAXI	1-g stress	stress/g	1-g stress	stress/g	1-g stress	stress/g	LANDING
stress, measured	-	7523	6898	7449	6830	7965	7304	4600
axial load	-	145	133	143	131	153	141	88
1st Pin Load	-	48	44	47	43	51	46	29
PSI								
S0 = axial load	0	5653	5184	5598	5133	5986	5489	3457
S3 = P/DT	0	11506	10550	11392	10446	12182	11171	7035
KSI								
S0 = between fstn	0.00	5.70	5.20	5.60	5.10	6.00	5.50	3.50
S3 = P/DT	0.00	11.50	10.50	11.40	10.40	12.20	11.20	7.00
constant value, s0		1.10		1.10		1.09		
constant value, s3		1.10		1.10		1.09		

B-6 PSE W6 SA227 Wing Extension Fitting Main Spar Lower Surface

PSE W6 - SA227 TIP EXTENSION AT END OF OUTBOARD FITTING @ 16,500 lbs

Main Spar Lower Surface,

NASFLA PROGRAM INPUT DATA FOR ALUM STRAP

Lower Spar Area	Area =	0.345	(Two .125 angles + .125 Cap) * 1.38 width at WS 260 (ref 27-33000)
Strap	W=	0.8	
Strap	t=	0.071	
Fastener	D=	0.19	
Fastener	ED=	0.38	

	TAXI	1-g stress Gust, com	stress/g Gust, com	1-g stress Gust, car	stress/g Gust, car	1-g stress Gust, exec	stress/g Gust, exec	LANDING
stress, measured	(2,000)	1,339	1,785					800
Load=stress*area	-	462	616					276
Between Fasteners	-	55	74					33
Fastener Load	-	69	92					41
PSI								
S0 = between fstn	0	976	1301					583
S3 = P/DT	0	5137	6848					3069
KSI								
S0 = between fstn	0.00	0.98	1.30					0.58
S3 = P/DT	0.00	5.14	6.85					3.07
constant value, s0		0.75						
constant value, s3		0.75						

B-7 PSE W7 SA227 Lower Wing Skin FWD Side MLG Trunnion at WS 113

PSE W7 - SA227 Lower wing skin on forward side of landing gear trunion at WS 113
NASFLA PROGRAM INPUT DATA FOR STRINGER

Stringer Area	Area =	0.047	horiz plate portion
Stringer Width	Width =	0.750	
Stringer thickness	t=	0.063	
Fastener Hole Diameter	D=	0.160	
Fastener Hole Edge Distance	B=	0.344	1/2 of (width-.063)

	TAXI 1-G	1-g stress	MAN/GUST stress/g	LANDING
stress, measured	-4000	7,900	7,400	4,600
load, stress*area	-188	371	348	216
1st rivet load	-43	85	80	50
Between Fasteners	-145	286	268	166
PSI				
S0+P/WT	-4000	7900	7400	4600
S0 = between fstn	-3080	6083	5698	3542
S3 = P/DT	-4290	8472	7936	4933
KSI				
S0+P/WT	-4.00	7.90	7.40	4.60
S0 = between fstn	-3.08	6.08	5.70	3.54
S3 = P/DT	-4.29	8.47	7.94	4.93
constant value, s0	1.00		1.07	0.00
constant value, s3	1.00		1.07	0.00

B-7 PSE W7 SA227 Lower Wing Skin FWD Side MLG Trunnion at WS 113 (Continued)

	NASTRAN			
			MAN/GUST	
	TAXI 1-G	1-g stress	stress/g	LANDING
stress, measured	-4000	7,900	7,400	4,600
load, stress*area	-188	371	348	216
1st rivet load	-37	73	68	42
Between Fasteners	-151	299	280	174
PSI				
S0+P/WT	-4000	7900	7400	4600
S0 = between fstn	-3216	6352	5950	3698
S3 = P/DT	-3656	7220	6763	4204
KSI				
S0+P/WT	-4.00	7.90	7.40	4.60
S0 = between fstn	-3.22	6.35	5.95	3.70
S3 = P/DT	-3.66	7.22	6.76	4.20
constant value, s0	1.00		1.07	0.00
constant value, s3	1.00		1.07	0.00

B-7 PSE W7 SA227 Lower Wing Skin FWD Side MLG Trunnion at WS 113 (Continued)

NASFLA PROGRAM INPUT DATA FOR SKIN WITH STRINGER BROKEN

Skin Area	Area =	0.024	(under width of stringer)
Skin Width	Width =	0.750	
Skin thickness	t=	0.032	
Fastener Hole Diameter	D=	0.160	

	TAXI 1-G	1-g stress	MAN/GUST stress/g	LANDING
stress, measured	-4000	7,900	7,400	4,600
stress, stringer broken	-4920	9717	9102	5658
load, stress*area	-118	233	218	136
1st rivet load	-52	103	96	60
Between Fasteners	-66	131	122	76
PSI				
S0+P/WT	-4920	9717	9102	5658
S0 = between fstn	-2755	5442	5097	3168
S3 = P/DT	-10148	20041	18773	11670
KSI				
S0+P/WT	-4.92	9.72	9.10	5.66
S0 = between fstn	-2.76	5.44	5.10	3.17
S3 = P/DT	-10.15	20.04	18.77	11.67
constant value, s0	1.00		1.07	0.00
constant value, s3	1.00		1.07	0.00

B-8 PSE W8 SA226 and SA227 Chordwise Skin Splice at WS 173.944

PSE W8 - SA226/227 Chordwise skin splice at WS 173.944 lower surface
NASFLA PROGRAM INPUT DATA FOR ALUM SKIN

Skin	Area =	0.015625
Skin	t=	0.025
Fastener	D=	0.125
Fastener	H=	0.625

	TAXI	1-g stress GUST	stress/g GUST	LANDING
stress	-1000	4,930	5,270	2,800
Stress*Area	-16	77	82	44
Between Fasteners	-8	37	40	21
1st fastner load	-8	40	43	23
PSI				
S0 = between fstn	-480	2366	2530	1344
S3 = P/DT	-2600	12818	13702	7280
KSI				
S0 = between fstn	-0.48	2.37	2.53	1.34
S3 = P/DT	-2.60	12.82	13.70	7.28
constant value, s0		0.94		
constant value, s3		0.94		

B-9 PSE W10 SA226 and SA227 Skin Splice at WS 27 Inboard

PSE W-10 - WING SKIN SPLICE AT STA 27, SA226
NASFLA PROGRAM INPUT DATA

skin	Area =	0.03	skin of .050 x .625 w
skin thickness	t=	0.05	
Fastener	D=	0.19	
Fastener spacing		0.625	

		Maneuver		
	TAXI	1-g stress	stress/g	LANDING
stress, measured	4,615	4,615	6,769	3,300
axial load	80	80	117	57
1st Pin Load	105	105	154	75
PSI				
S0 = axial load	2551	2551	3741	1824
S3 = P/DT	11041	11041	16194	7895
KSI				
S0 = between fstn	2.55	2.60	3.70	1.80
S3 = P/DT	11.04	11.00	16.20	7.90
constant value, s0		0.70		
constant value, s3		0.68		

B-10 PSE W11 SA226 Wing Lower Center Section Skin at Landing Light Cutout

PSE W11 - SA226 Wing lower center section skin at landing light cut out.
NASFLA PROGRAM INPUT DATA FOR ALUM SKIN

Belly skin	t=	0.05	at splice
Belly skin	W=	5	dist bewteen rear spar and splice strap
Belly skin	Area=	0.25	at splice

	TAXI	1-g stress GUST	stress/g GUST	LANDING	
stress, measured	-1000	4,615	6,769	2,100	Tables E-12 and D-8
stress at fillet	-2000	9230	13538	4200	Kt=2.0
PSI					
S0	-2000	9230	13538	4200	
KSI					
S0	-2.00	9.23	13.54	4.20	
constant value, s0		0.68			

B-11 PSE W12 SA227 Tip Extension Fitting Rear Spar Lower Surface

NASFLA PROGRAM INPUT DATA FOR ALUM ANGLE

Angle, Aera	Area =	0.2344
Angle, flange	t=	0.125
Fastener	D=	0.19

	TAXI	1-g stress Gust, com	stress/g Gust, com	1-g stress Gust, car	stress/g Gust, car	1-g stress Gust, exec	stress/g Gust, exec	LANDING
stress, meas	(2,000)	805	1,073	834	1,111	930	1,239	500
1st Pin Load	(285)	74	98	77	102	85	114	46
Between Fast	(183)	115	153	119	159	133	177	71
Apply Load	(468)	189	251	196	261	218	291	117
PSI								
S0 = between	-781	491	653	508	678	567	755	303
S3 = P/DT	-12000	3116	4126	3242	4295	3579	4800	1937
KSI								
S0 = between	-0.78	0.49	0.65	0.51	0.68	0.57	0.76	0.30
S3 = P/DT	-12.00	3.12	4.13	3.24	4.29	3.58	4.80	1.94
constant value, s0		0.75		0.75		0.75		
constant value, s3		0.76		0.76		0.75		

NASFLA PROGRAM INPUT DATA FOR ALUM ANGLE

Angle, Aera	Area =	0.2344
Angle, flange	t=	0.125
Fastener	D=	0.19

	TAXI	1-g stress Gust, com	stress/g Gust, com	1-g stress Gust, car	stress/g Gust, car	1-g stress Gust, exec	stress/g Gust, exec	LANDING
stress, meas	(2,000)	805	1,073	834	1,111	930	1,239	500
1st Pin Load	(245)	90	120	93	124	104	139	56
Between Fast	(224)	98	131	102	136	114	152	61
Apply Load	(469)	188	251	195	260	218	291	117
PSI								
S0 = between	-956	418	559	435	580	486	648	260
S3 = P/DT	-10316	3789	5053	3916	5221	4379	5853	2358
KSI								
S0 = between	-0.96	0.42	0.56	0.44	0.58	0.49	0.65	0.26
S3 = P/DT	-10.32	3.79	5.05	3.92	5.22	4.38	5.85	2.36
constant value, s0		0.75		0.76		0.75		
constant value, s3		0.75		0.75		0.75		

B-12 PSE W13 SA227 Tip Extension at End of Outboard Fitting Rear Spar Lower Surface

PSE W13 - SA227 TIP EXTENSION AT END OF OUTBOARD FITTING @ 16,500 lbs
Rear Spar Lower Surface, AFT C.G. (R1517 - Page A-87)

NASFLA PROGRAM INPUT DATA FOR ALUM ANGLE

Spar Cap Angles	Area =	0.06048	0.06048 longer leg is used for steel fitting attachment
Angle, flange thick	t=	0.063	
Fastener	D=	0.19	
Fastener	ED=	0.38	

	TAXI	1-g stress Gust, com	stress/g Gust, com	1-g stress Gust, car	stress/g Gust, car	1-g stress Gust, exec	stress/g Gust, exec	LANDING
stress, measured	(2,000)	1,779	1,779	1,842	2,314	2,054	2,580	500
Between Fasteners	-	112	112	116	145	129	162	31
1st Pin Load	-	75	75	78	98	87	109	21
PSI								
S0 = between fstn	0	1852	1852	1918	2397	2133	2679	513
S3 = P/DT	0	6266	6266	6516	8187	7268	9106	1754
KSI								
S0 = between fstn	0.00	1.85	1.85	1.92	2.40	2.13	2.68	0.51
S3 = P/DT	0.00	6.27	6.27	6.52	8.19	7.27	9.11	1.75
constant value, s0		1.00		0.80		0.79		
constant value, s3		1.00		0.80		0.80		

B-13 PSE W14 SA227 Tip Extension at End of Outboard Fitting Main Spar Lower Surface

PSE W14 - SA227 TIP EXTENSION AT END OF OUTBOARD FITTING
Main Spar Lower Surface, AFT C.G. (R1517 - Page A-87)

NASFLA PROGRAM INPUT DATA FOR ALUM ANGLE

Spar Cap Angles	Area =	0.09375
Angle, flange thick	t=	0.125
Fastener	D=	0.19
Fastener	ED=	0.38

	TAXI	1-g stress Gust, com	stress/g Gust, com	1-g stress Gust, car	stress/g Gust, car	1-g stress Gust, exec	stress/g Gust, exec	LANDING
stress, measured	-	805	1,073	834	1,111	930	1,239	800
Between Fasteners	-	25	33	26	35	29	39	25
1st Pin Load	-	50	67	52	69	58	77	50
PSI								
S0 = between fstn	0	268	357	278	370	310	413	266
S3 = P/DT	0	2120	2825	2196	2925	2449	3262	2107
KSI								
S0 = between fstn	0.00	0.27	0.36	0.28	0.37	0.31	0.41	0.27
S3 = P/DT	0.00	2.12	2.83	2.20	2.93	2.45	3.26	2.11
constant value, s0		0.75		0.76		0.76		
constant value, s3		0.75		0.75		0.75		

B-14 PSE EM1 Upper Engine Mount at Firewall

PSE EM1 Upper Engine Mount at Firewall - Pre S/B

PLATE
NASGRO TC01
.05 through crack at washer OD

plate t=	0.125	
plate W=	2.45	circumference at washer OD

	TAXI	1-G	GUST Per G	LAND	
Load (2 mounts)	644	1424	644	644	from fbd of mount truss
Load per mount	644	1424	644	644	assuming one mount carries all load
S0 ksi	28.68	63.42	28.68	28.68	
Constant	2.21		2.21	2.21	

WELD
NASGRO TC08
Through crack around .05 of weld circumference

weld t=	0.205	
c=	0.025	initial crack half-length

	TAXI	1-G	GUST Per G	LAND	
Load (2 mounts)	644	1424	644	644	from fbd of mount truss
Load per mount	644	1424	644	644	assuming one mount carries all load
S0 ksi	7.97	17.62	7.97	7.97	
Constant	2.21		2.21	2.21	

B-15 PSE N1 Upper Longeron at Firewall

PSE N1 - SA226/227 Nacelle upper longeron at firewall

NASFLA PROGRAM INPUT DATA FOR CAP

Cap area	Area =	0.203	effective area at end of steel fitting
Cap thickness	t=	0.090	
Fastener dia	D=	0.156	prior to repair for elongated holes
Fastener edge dist	B=	1.125	in upward direction

	TAXI 1-G	1-g stress	MAN/GUST stress/g	LANDING	
applied load, upper truss	644	1,424	644	644	from fbd of mount truss
load per fitting	644	1424	644	644	assuming 1 fitting bears all load
1st rivet load	303	669	303	303	
Between Fasteners	341	755	341	341	
PSI					
S0+P/WT	3180	7032	3180	3180	
S0 = between fstn	1686	3727	1686	1686	
S3 = P/DT	21558	47670	21558	21558	
KSI					
S0+P/WT	3.18	7.03	3.18	3.18	
S0 = between fstn	1.69	3.73	1.69	1.69	
S3 = P/DT	21.56	47.67	21.56	21.56	
constant value, s0	2.21		2.21	2.21	
constant value, s3	2.21		2.21	2.21	

B-16 PSE N2 Upper Longeron at Wing Rib Attach Angles

PSE N2 - SA226/227 Nacelle upper longeron at wing rib attach angle

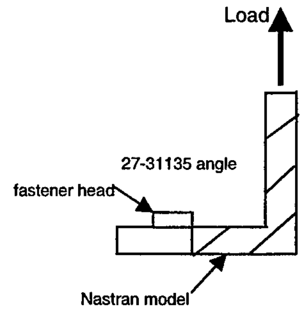
NASFLA PROGRAM INPUT DATA FOR CAP

Cap, at gage 28	Area =	0.217
Cap	t=	0.090
Fastener	D=	0.188

	TAXI	1-g stress	MAN/GUST stress/g	LANDING	
stress, measured	394	-956	394	174	gage 28
load, stress*area	85	-207	85	38	
1st fastener load	69	-168	69	31	from NASTRAN model
PSI					
S3 = P/DT	4091	-9927	4091	1807	
KSI					
S3 = P/DT	4.09	-9.93	4.09	1.81	
constant value, s3	-2.43		-2.43	0.00	

B-17 PSE N3 Upper Longeron to Wing Rib Attach Angles

PSE N3 - SA226/227 Nacelle upper longeron wing rib attach angles



NASFLA PROGRAM INPUT DATA FOR ANGLE

Cap, at gage 28 Area = 0.217

	TAXI	1-g stress	MAN/GUST stress/g	LANDING	
stress, measured gage 28	394	-956	394	174	
load, stress*cap area	43	-104	43	19	load is divided by 2 since 2 angles carry load
FEM Stress	6409	-15552	6409	2831	Stress is 150 times applied load in Nastran model
PSI					
S1	6409	-15552	6409	2831	
KSI					
S1	6.41	-15.55	6.41	2.83	
constant value, s1	-2.43		-2.43	0.00	

B-18 PSE H1 Horizontal Stabilizer Rib Strap at Rear Spar BL 3.1

NASFLA PROGRAM INPUT DATA FOR STRAP

Strap Area	Area =	0.125	horiz plate portion
Strap Width	Width =	1.000	
Stap thickness	t=	0.125	
Fastener Hole Diameter	D=	0.190	
Fastener Hole Edge Distance	B=	0.500	

	TAXI	1-g stress	MAN/GUST stress/g	Prop Wash
stress, calc	733	733	2,305	1,950
load, stress*area	92	92	288	244
1st rivet load	24	24	75	63
Between Fasteners	68	68	213	180
PSI				
S0+P/WT	733	733	2305	1950
S0 = between fstn	542	542	1706	1443
S3 = P/DT	1003	1003	3154	2668
KSI				
S0+P/WT	0.73	0.73	2.31	1.95
S0 = between fstn	0.54	0.54	1.71	1.44
S3 = P/DT	1.00	1.00	3.15	2.67
constant value, s0	1.00		0.32	0.00
constant value, s3	1.00		0.32	0.00

B-19 PSE V1 Vertical Fin Main Spar Cap Strips Below Pivot Fitting

Case A

NASFLA PROGRAM INPUT DATA				
.090 Strap, 1st fstnr	t=	0.09		
Fastener	D=	0.16		
Fastener	Edge Dist=	0.35		
		Table D-7	Table D-8	
	TAXI	1-G	Stress/G	Propwash
stress, gage 15	0	0	1164	1170
Correction Factor	0	0	1.51	1.52
(=measured/unit load case)				
PSI				
S0 = between fstn	0	0	0	0
S3 = P/DT	4385	0	4385	4408
KSI				
S0 = between fstn	0.00	0.00	0.00	0.00
S3 = P/DT	4.39	0.00	4.39	4.41
constant value, s0	1		0.00	0
constant value, s3	1		0.00	0
Schedule				
	1	short		
	3	medium		
	1	long		

Case B

NASFLA PROGRAM INPUT DATA				
Channel, 1st fstnr	t=	0.19		
Fastener	D=	0.16		
Fastener	Edge Dist=	0.35		
		Table D-7	Table D-8	
	TAXI	1-G	Stress/G	Propwash
stress, gage 15	0	0	1164	1170
Correction Factor	0	0	1.51	1.52
(=measured/unit load case)				
PSI				
S0 = between fstn	0	0	0	0
S3 = P/DT	3931	0	3931	3951
KSI				
S0 = between fstn	0.00	0.00	0.00	0.00
S3 = P/DT	3.93	0.00	3.93	3.95
constant value, s0	1		0.00	0
constant value, s3	1		0.00	0
Schedule				
	1	short		
	3	medium		
	1	long		

B-20 PSE F1 T-Stringer, Top Centerline Near FS 300

Hoop Stress =	Pr /t=	5775				
	P=	7				
	r=	33				
	t=	0.04				
					PRESS	GUST
2024-T3 alum skin	S3=	P/Dt				
	S3=	33300	bearing stress	S4=	3550	1300
				Const=	0	2.73
	P=	Hoop*H*t				
	P=	173.25	bearing load			
	Hoop Stress=	5775				
	H=	0.75	Fastener Spacing			
	t=	0.04	Thickness of skin			
	D=	0.13	#4 Fastener			
	t=	0.04	Skin thickness			
2014-T6 T-stringer	S3=	P/Dt				
	S3=	26700	bearing stress	S4=	3550	1300
				Const=	0	2.73
	P=	Hoop*H*t				
	P=	173.25	bearing load			
	Hoop Stress=	5775				
	H=	0.75	Fastener Spacing			
	t=	0.04	Thickness of skin			
	D=	0.13	#4 Fastener			
	t=	0.05	Stringer thickness			
7075-T73 T-stringer	S3=	P/Dt				
	S3=	21200	bearing stress	S4=	3550	1300
				Const=	0	2.73
	P=	Hoop*H*t				
	P=	173.25	bearing load			
	Hoop Stress=	5775				
	H=	0.75	Fastener Spacing			
	t=	0.04	Thickness of skin			
	D=	0.13	#4 Fastener			
	t=	0.063	Stringer thickness			

APPENDIX C NASGRO OUTPUT FILES

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99

FATIGUE CRACK GROWTH ANALYSIS
-------Modified by FAI-------
DATE: 05-OCT-98 TIME: 10:13:40
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

CORNER CRACK CASE 2, PSE-W1 SA226 MS, crack in angle WS 99

GEOMETRY

MODEL: CC02-Corner crack from hole in plate (2D)

```
Plate Thickness, t =    0.1250
Plate Width, W     =    1.4400
Hole Diameter, D   =    0.1600
Hole-Center-to-Edge Dist., B =    0.3100
Poisson s ratio    =    0.30
```

FLAW SIZE:

```
a   (init.) =  0.5000E-01
c   (init.) =  0.5000E-01
a/c (init.) =   1.000
```

MATERIAL

MATL 1:
1 2014T6511 EXTRUSION T-L

Material Properties:

Matl No.	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	74.0	65.0	27.0	27.0	1.00	1.00	0.125	51.8	

Matl No.	C	n	p	q	DKo	Rcl	Alpha	Smax/ SIGo
	Crack Growth Eqn Constants							
1	0.200D-08	3.700	0.50	1.00	2.70	0.70	5.84	1.00

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

```
Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 3.8400
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 9.6200

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 3.8400
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 9.6200

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 3.8400
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 9.6200

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 2.9000
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 7.2500

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	1.90	0.70	1.30	0.00	0.00
2	1	0.09	0.60	1.40	0.00	0.00
3	1	0.01	0.54	1.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

BLOCK CASE NO. 2

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	9.57	0.60	1.20	-0.30	0.30
2	1	1.14	0.40	1.40	-0.50	0.50
3	1	0.57	0.30	1.50	-0.60	0.60
4	1	0.11	0.10	1.70	-0.80	0.80
5	1	0.02	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	9.57	0.60	1.20	0.00	0.00
2	1	1.14	0.40	1.40	0.00	0.00
3	1	0.57	0.30	1.50	0.00	0.00
4	1	0.11	0.10	1.70	0.00	0.00
5	1	0.02	-0.10	1.90	0.00	0.00
6	1	0.01	-0.30	2.10	0.00	0.00
7	1	0.00	-0.50	2.30	0.00	0.00
8	1	0.00	-0.70	2.50	0.00	0.00
9	1	0.00	-0.90	2.70	0.00	0.00
10	1	0.00	-1.10	2.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.60	1.20	-0.30	0.30
2	1	2.29	0.40	1.40	-0.50	0.50
3	1	1.14	0.30	1.50	-0.60	0.60
4	1	0.23	0.10	1.70	-0.80	0.80
5	1	0.04	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	19.14	0.60	1.20	0.00	0.00
2	1	2.29	0.40	1.40	0.00	0.00
3	1	1.14	0.30	1.50	0.00	0.00
4	1	0.23	0.10	1.70	0.00	0.00
5	1	0.04	-0.10	1.90	0.00	0.00
6	1	0.01	-0.30	2.10	0.00	0.00
7	1	0.00	-0.50	2.30	0.00	0.00
8	1	0.00	-0.70	2.50	0.00	0.00
9	1	0.00	-0.90	2.70	0.00	0.00
10	1	0.00	-1.10	2.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.60	1.20	-0.30	0.30
2	1	4.57	0.40	1.40	-0.50	0.50
3	1	2.29	0.30	1.50	-0.60	0.60
4	1	0.46	0.10	1.70	-0.80	0.80
5	1	0.08	-0.10	1.90	-1.00	1.00
6	1	0.02	-0.30	2.10	-1.20	1.20
7	1	0.01	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	38.29	0.60	1.20	0.00	0.00
2	1	4.57	0.40	1.40	0.00	0.00
3	1	2.29	0.30	1.50	0.00	0.00
4	1	0.46	0.10	1.70	0.00	0.00
5	1	0.08	-0.10	1.90	0.00	0.00
6	1	0.02	-0.30	2.10	0.00	0.00
7	1	0.01	-0.50	2.30	0.00	0.00
8	1	0.00	-0.70	2.50	0.00	0.00
9	1	0.00	-0.90	2.70	0.00	0.00
10	1	0.00	-1.10	2.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	2.30	4.61	0.00	0.00
2	1	1.14	1.54	5.38	0.00	0.00
3	1	0.57	1.15	5.76	0.00	0.00
4	1	0.11	0.38	6.53	0.00	0.00
5	1	0.02	-0.38	7.30	0.00	0.00
6	1	0.01	-1.15	8.06	0.00	0.00
7	1	0.00	-1.92	8.83	0.00	0.00
8	1	0.00	-2.69	9.60	0.00	0.00
9	1	0.00	-3.46	10.37	0.00	0.00
10	1	0.00	-4.22	11.14	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	5.77	11.54	0.00	0.00
2	1	1.14	3.85	13.47	0.00	0.00
3	1	0.57	2.89	14.43	0.00	0.00
4	1	0.11	0.96	16.35	0.00	0.00
5	1	0.02	-0.96	18.28	0.00	0.00
6	1	0.01	-2.89	20.20	0.00	0.00
7	1	0.00	-4.81	22.13	0.00	0.00
8	1	0.00	-6.73	24.05	0.00	0.00
9	1	0.00	-8.66	25.97	0.00	0.00
10	1	0.00	-10.58	27.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	2.30	4.61	0.00	0.00
2	1	2.29	1.54	5.38	0.00	0.00
3	1	1.14	1.15	5.76	0.00	0.00
4	1	0.23	0.38	6.53	0.00	0.00
5	1	0.04	-0.38	7.30	0.00	0.00
6	1	0.01	-1.15	8.06	0.00	0.00
7	1	0.00	-1.92	8.83	0.00	0.00
8	1	0.00	-2.69	9.60	0.00	0.00
9	1	0.00	-3.46	10.37	0.00	0.00
10	1	0.00	-4.22	11.14	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	5.77	11.54	0.00	0.00
2	1	2.29	3.85	13.47	0.00	0.00
3	1	1.14	2.89	14.43	0.00	0.00
4	1	0.23	0.96	16.35	0.00	0.00
5	1	0.04	-0.96	18.28	0.00	0.00
6	1	0.01	-2.89	20.20	0.00	0.00
7	1	0.00	-4.81	22.13	0.00	0.00
8	1	0.00	-6.73	24.05	0.00	0.00
9	1	0.00	-8.66	25.97	0.00	0.00
10	1	0.00	-10.58	27.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	2.30	4.61	0.00	0.00
2	1	4.57	1.54	5.38	0.00	0.00
3	1	2.29	1.15	5.76	0.00	0.00
4	1	0.46	0.38	6.53	0.00	0.00
5	1	0.08	-0.38	7.30	0.00	0.00
6	1	0.02	-1.15	8.06	0.00	0.00
7	1	0.01	-1.92	8.83	0.00	0.00
8	1	0.00	-2.69	9.60	0.00	0.00
9	1	0.00	-3.46	10.37	0.00	0.00
10	1	0.00	-4.22	11.14	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	38.29	5.77	11.54	0.00	0.00

2	1	4.57	3.85	13.47	0.00	0.00
3	1	2.29	2.89	14.43	0.00	0.00
4	1	0.46	0.96	16.35	0.00	0.00
5	1	0.08	-0.96	18.28	0.00	0.00
6	1	0.02	-2.89	20.20	0.00	0.00
7	1	0.01	-4.81	22.13	0.00	0.00
8	1	0.00	-6.73	24.05	0.00	0.00
9	1	0.00	-8.66	25.97	0.00	0.00
10	1	0.00	-10.58	27.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.28	2.90	2.93	0.00	0.00
2	1	0.44	2.35	3.07	0.00	0.00
3	1	0.22	1.80	3.25	0.00	0.00
4	1	0.06	1.25	3.42	0.00	0.00
5	1	0.00	0.67	3.60	0.00	0.00
6	1	0.00	0.12	3.77	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	7.25	7.25	0.00	0.00
2	1	0.44	5.87	7.69	0.00	0.00
3	1	0.22	4.50	8.12	0.00	0.00
4	1	0.06	3.12	8.55	0.00	0.00
5	1	0.00	1.67	8.99	0.00	0.00
6	1	0.00	0.29	9.43	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15	0.053229	0.050622	4.329698	3.103968
400	15	0.056521	0.051348	4.347850	3.192783
600	15	0.059873	0.052181	4.364683	3.276225
800	15	0.063279	0.053121	4.380751	3.354709
1000	15	0.066741	0.054172	4.396494	3.428725
1200	15	0.070256	0.055335	4.412247	3.498799
1400	15	0.073827	0.056610	4.428252	3.565475
1600	15	0.077456	0.058001	4.444673	3.629289
1800	15	0.081144	0.059509	4.461608	3.690766
2000	15	0.084895	0.061136	4.479105	3.750407
2200	15	0.088711	0.062885	4.497176	3.808687

2400	15	0.092595	0.064760	4.515804	3.866054
2600	15	0.096550	0.066766	4.534949	3.922934
2800	15	0.100580	0.068910	4.554553	3.979725
3000	15	0.104687	0.071196	4.574541	4.036807
3200	15	0.108873	0.073635	4.594826	4.094533
3400	15	0.113140	0.076234	4.615301	4.153240
3600	15	0.117491	0.079006	4.635838	4.213236
3800	15	0.121927	0.081962	4.656284	4.274807

```
Transition to 1-d solution, TC03:
a =    0.1250       t =    0.1250
at Cycle No.           1.14  of Load Step No.   3
Step description:
of Block No.       8  of Schedule No.    3937
Crack Size:  c =  0.840928E-01 ,  a/c =    1.48646
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
4000	15		0.085385	4.296394
4200	15		0.089528	4.326786
4400	15		0.093805	4.361495
4600	15		0.098238	4.401221
4800	15		0.102858	4.446874
5000	15		0.107699	4.499661
5200	15		0.112808	4.561234
5400	15		0.118244	4.633927
5600	15		0.124092	4.721171
5800	15		0.130468	4.828290
6000	15		0.137553	4.964143
6200	15		0.145646	5.145029
6400	15		0.155307	5.405872
6600	15		0.167848	5.844639
6800	15		0.188504	7.005754

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     54.23      K ref =     0.000      K cr =     51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.       8  of Schedule No.    6888
Crack Size      c =  0.224301

                 FATIGUE CRACK GROWTH ANALYSIS
                -------Modified by FAI-------
               DATE: 05-OCT-98    TIME: 10:17:32
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W1 SA226 MS, crack in cap WS 99    (

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =     0.1250
Plate Width, W     =     3.0000
Hole Diameter, D   =     0.1600
Hole-Center-to-Edge Dist., B =     0.3100
Poisson s ratio    =     0.30

FLAW SIZE:

a   (init.) =  0.5000E-01
c   (init.) =  0.5000E-01
```

```
a/c (init.) =   1.000



MATERIAL
--------

MATL 1:
       1        2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak  :  Bk  :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :      :      :       :      :      :
:----:------:------:------:------:------:------:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p  :  q  :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :     :     :      :      :     :SIGo :
:----:-----------:-----:-----:-----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    6.6000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    6.6000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    6.6000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.5000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    4.9700

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

From	-	To	
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	1.90	0.70	1.30	0.00	0.00
2	1	0.09	0.60	1.40	0.00	0.00
3	1	0.01	0.54	1.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	9.57	0.60	1.20	-0.30	0.30
2	1	1.14	0.40	1.40	-0.50	0.50
3	1	0.57	0.30	1.50	-0.60	0.60
4	1	0.11	0.10	1.70	-0.80	0.80
5	1	0.02	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	9.57	0.60	1.20	0.00	0.00
2	1	1.14	0.40	1.40	0.00	0.00
3	1	0.57	0.30	1.50	0.00	0.00
4	1	0.11	0.10	1.70	0.00	0.00
5	1	0.02	-0.10	1.90	0.00	0.00
6	1	0.01	-0.30	2.10	0.00	0.00
7	1	0.00	-0.50	2.30	0.00	0.00

8:	1:	0.00 :	-0.70:	2.50:	0.00:	0.00:
9:	1:	0.00 :	-0.90:	2.70:	0.00:	0.00:
10:	1:	0.00 :	-1.10:	2.90:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	19.14 :	0.60:	1.20:	-0.30:	0.30:
2:	1:	2.29 :	0.40:	1.40:	-0.50:	0.50:
3:	1:	1.14 :	0.30:	1.50:	-0.60:	0.60:
4:	1:	0.23 :	0.10:	1.70:	-0.80:	0.80:
5:	1:	0.04 :	-0.10:	1.90:	-1.00:	1.00:
6:	1:	0.01 :	-0.30:	2.10:	-1.20:	1.20:
7:	1:	0.00 :	-0.50:	2.30:	-1.40:	1.40:
8:	1:	0.00 :	-0.70:	2.50:	-1.60:	1.60:
9:	1:	0.00 :	-0.90:	2.70:	-1.80:	1.80:
10:	1:	0.00 :	-1.10:	2.90:	-2.00:	2.00:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	19.14 :	0.60:	1.20:	0.00:	0.00:
2:	1:	2.29 :	0.40:	1.40:	0.00:	0.00:
3:	1:	1.14 :	0.30:	1.50:	0.00:	0.00:
4:	1:	0.23 :	0.10:	1.70:	0.00:	0.00:
5:	1:	0.04 :	-0.10:	1.90:	0.00:	0.00:
6:	1:	0.01 :	-0.30:	2.10:	0.00:	0.00:
7:	1:	0.00 :	-0.50:	2.30:	0.00:	0.00:
8:	1:	0.00 :	-0.70:	2.50:	0.00:	0.00:
9:	1:	0.00 :	-0.90:	2.70:	0.00:	0.00:
10:	1:	0.00 :	-1.10:	2.90:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	38.29 :	0.60:	1.20:	-0.30:	0.30:
2:	1:	4.57 :	0.40:	1.40:	-0.50:	0.50:
3:	1:	2.29 :	0.30:	1.50:	-0.60:	0.60:
4:	1:	0.46 :	0.10:	1.70:	-0.80:	0.80:
5:	1:	0.08 :	-0.10:	1.90:	-1.00:	1.00:
6:	1:	0.02 :	-0.30:	2.10:	-1.20:	1.20:
7:	1:	0.01 :	-0.50:	2.30:	-1.40:	1.40:
8:	1:	0.00 :	-0.70:	2.50:	-1.60:	1.60:
9:	1:	0.00 :	-0.90:	2.70:	-1.80:	1.80:
10:	1:	0.00 :	-1.10:	2.90:	-2.00:	2.00:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	38.29 :	0.60:	1.20:	0.00:	0.00:
2:	1:	4.57 :	0.40:	1.40:	0.00:	0.00:

3:	1:	2.29 :	0.30:	1.50:	0.00:	0.00:
4:	1:	0.46 :	0.10:	1.70:	0.00:	0.00:
5:	1:	0.08 :	-0.10:	1.90:	0.00:	0.00:
6:	1:	0.02 :	-0.30:	2.10:	0.00:	0.00:
7:	1:	0.01 :	-0.50:	2.30:	0.00:	0.00:
8:	1:	0.00 :	-0.70:	2.50:	0.00:	0.00:
9:	1:	0.00 :	-0.90:	2.70:	0.00:	0.00:
10:	1:	0.00 :	-1.10:	2.90:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	0.28 :	1.00:	1.01:	1.00:	1.01:
2:	1:	0.44 :	0.81:	1.06:	0.81:	1.06:
3:	1:	0.22 :	0.62:	1.12:	0.62:	1.12:
4:	1:	0.06 :	0.43:	1.18:	0.42:	1.18:
5:	1:	0.00 :	0.23:	1.24:	0.23:	1.24:
6:	1:	0.00 :	0.04:	1.30:	0.04:	1.30:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	0.28 :	1.00:	1.00:	0.00:	0.00:
2:	1:	0.44 :	0.81:	1.06:	0.00:	0.00:
3:	1:	0.22 :	0.62:	1.12:	0.00:	0.00:
4:	1:	0.06 :	0.43:	1.18:	0.00:	0.00:
5:	1:	0.00 :	0.23:	1.24:	0.00:	0.00:
6:	1:	0.00 :	0.04:	1.30:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	1.90 :	-0.70:	-1.30:	0.00:	0.00:
2:	1:	0.09 :	-0.60:	-1.40:	0.00:	0.00:
3:	1:	0.01 :	-0.54:	-1.46:	0.00:	0.00:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	1.90 :	-0.70:	-1.30:	0.00:	0.00:
2:	1:	0.09 :	-0.60:	-1.40:	0.00:	0.00:
3:	1:	0.01 :	-0.54:	-1.46:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	2.78	5.57	0.00	0.00
2	1	1.14	1.86	6.50	0.00	0.00
3	1	0.57	1.39	6.96	0.00	0.00
4	1	0.11	0.46	7.89	0.00	0.00
5	1	0.02	-0.46	8.82	0.00	0.00
6	1	0.01	-1.39	9.74	0.00	0.00
7	1	0.00	-2.32	10.67	0.00	0.00
8	1	0.00	-3.25	11.60	0.00	0.00
9	1	0.00	-4.18	12.53	0.00	0.00
10	1	0.00	-5.10	13.46	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	3.96	7.92	0.00	0.00
2	1	1.14	2.64	9.24	0.00	0.00
3	1	0.57	1.98	9.90	0.00	0.00
4	1	0.11	0.66	11.22	0.00	0.00
5	1	0.02	-0.66	12.54	0.00	0.00
6	1	0.01	-1.98	13.86	0.00	0.00
7	1	0.00	-3.30	15.18	0.00	0.00
8	1	0.00	-4.62	16.50	0.00	0.00
9	1	0.00	-5.94	17.82	0.00	0.00
10	1	0.00	-7.26	19.14	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	2.78	5.57	0.00	0.00
2	1	2.29	1.86	6.50	0.00	0.00
3	1	1.14	1.39	6.96	0.00	0.00
4	1	0.23	0.46	7.89	0.00	0.00
5	1	0.04	-0.46	8.82	0.00	0.00
6	1	0.01	-1.39	9.74	0.00	0.00
7	1	0.00	-2.32	10.67	0.00	0.00
8	1	0.00	-3.25	11.60	0.00	0.00
9	1	0.00	-4.18	12.53	0.00	0.00
10	1	0.00	-5.10	13.46	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	3.96	7.92	0.00	0.00
2	1	2.29	2.64	9.24	0.00	0.00

3:	1:	1.14 :	1.98:	9.90:	0.00:	0.00:
4:	1:	0.23 :	0.66:	11.22:	0.00:	0.00:
5:	1:	0.04 :	-0.66:	12.54:	0.00:	0.00:
6:	1:	0.01 :	-1.98:	13.86:	0.00:	0.00:
7:	1:	0.00 :	-3.30:	15.18:	0.00:	0.00:
8:	1:	0.00 :	-4.62:	16.50:	0.00:	0.00:
9:	1:	0.00 :	-5.94:	17.82:	0.00:	0.00:
10:	1:	0.00 :	-7.26:	19.14:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	38.29 :	2.78:	5.57:	0.00:	0.00:
2:	1:	4.57 :	1.86:	6.50:	0.00:	0.00:
3:	1:	2.29 :	1.39:	6.96:	0.00:	0.00:
4:	1:	0.46 :	0.46:	7.89:	0.00:	0.00:
5:	1:	0.08 :	-0.46:	8.82:	0.00:	0.00:
6:	1:	0.02 :	-1.39:	9.74:	0.00:	0.00:
7:	1:	0.01 :	-2.32:	10.67:	0.00:	0.00:
8:	1:	0.00 :	-3.25:	11.60:	0.00:	0.00:
9:	1:	0.00 :	-4.18:	12.53:	0.00:	0.00:
10:	1:	0.00 :	-5.10:	13.46:	0.00:	0.00:

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	38.29 :	3.96:	7.92:	0.00:	0.00:
2:	1:	4.57 :	2.64:	9.24:	0.00:	0.00:
3:	1:	2.29 :	1.98:	9.90:	0.00:	0.00:
4:	1:	0.46 :	0.66:	11.22:	0.00:	0.00:
5:	1:	0.08 :	-0.66:	12.54:	0.00:	0.00:
6:	1:	0.02 :	-1.98:	13.86:	0.00:	0.00:
7:	1:	0.01 :	-3.30:	15.18:	0.00:	0.00:
8:	1:	0.00 :	-4.62:	16.50:	0.00:	0.00:
9:	1:	0.00 :	-5.94:	17.82:	0.00:	0.00:
10:	1:	0.00 :	-7.26:	19.14:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28 :	3.50:	3.54:	0.00:	0.00:
2:	1:	0.44 :	2.83:	3.71:	0.00:	0.00:
3:	1:	0.22 :	2.17:	3.92:	0.00:	0.00:
4:	1:	0.06 :	1.50:	4.13:	0.00:	0.00:

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
  5: 1:        0.00 :   0.81:    4.34:    0.00:    0.00:
  6: 1:        0.00 :   0.14:    4.55:    0.00:    0.00:
S  : M:  NUMBER     :     S3           :     S          :
T  : A:   OF        :                  :                :
E  : T:  FATIGUE    :    (ksi)         :    (ksi)       :
P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2) :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        0.28 :   4.97:    4.97:    0.00:    0.00:
  2: 1:        0.44 :   4.03:    5.27:    0.00:    0.00:
  3: 1:        0.22 :   3.08:    5.57:    0.00:    0.00:
  4: 1:        0.06 :   2.14:    5.86:    0.00:    0.00:
  5: 1:        0.00 :   1.14:    6.16:    0.00:    0.00:
  6: 1:        0.00 :   0.20:    6.46:    0.00:    0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block	Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15		0.052092	0.050426	3.928069	2.884224
400	15		0.054215	0.050903	3.940099	2.939992
600	15		0.056365	0.051434	3.951676	2.993588
800	15		0.058544	0.052017	3.962959	3.045121
1000	15		0.060751	0.052655	3.974083	3.094720
1200	15		0.062985	0.053347	3.985165	3.142524
1400	15		0.065247	0.054094	3.996302	3.188681
1600	15		0.067538	0.054897	4.007574	3.233344
1800	15		0.069857	0.055756	4.019042	3.276666
2000	15		0.072207	0.056673	4.030753	3.318804
2200	15		0.074587	0.057647	4.042742	3.359911
2400	15		0.076999	0.058681	4.055031	3.400139
2600	15		0.079444	0.059775	4.067633	3.439635
2800	15		0.081923	0.060930	4.080553	3.478542
3000	15		0.084438	0.062148	4.093789	3.517001
3200	15		0.086989	0.063431	4.107334	3.555148
3400	15		0.089578	0.064780	4.121178	3.593112
3600	15		0.092207	0.066197	4.135302	3.631023
3800	15		0.094875	0.067686	4.149687	3.669005
4000	15		0.097586	0.069248	4.164307	3.707179
4200	15		0.100338	0.070886	4.179137	3.745662
4400	15		0.103135	0.072605	4.194145	3.784568
4600	15		0.105976	0.074407	4.209296	3.824007
4800	15		0.108863	0.076298	4.224551	3.864085
5000	15		0.111797	0.078282	4.239865	3.904905
5200	15		0.114777	0.080363	4.255185	3.946565
5400	15		0.117805	0.082548	4.270448	3.989154
5600	15		0.120881	0.084843	4.285582	4.032757
5800	15		0.124005	0.087255	4.300501	4.077444

Transition to 1-d solution, TC03:
a = 0.1250 t = 0.1250
at Cycle No. 0.11 of Load Step No. 4
Step description:
of Block No. 2 of Schedule No. 5864
Crack Size: c = 0.880408E-01 , a/c = 1.41980

Schdl Block Final Flaw Size K max

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

	Step	c	c-tip
6000	15	0.090855	4.314172
6200	15	0.095113	4.358583
6400	15	0.099572	4.408757
6600	15	0.104268	4.465906
6800	15	0.109245	4.531675
7000	15	0.114564	4.608363
7200	15	0.120309	4.699327
7400	15	0.126595	4.809722
7600	15	0.133602	4.948033
7800	15	0.141621	5.129629
8000	15	0.151189	5.386680
8200	15	0.163526	5.805567
8400	15	0.183012	6.803264

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =    52.47     K ref =    0.000     K cr =    51.83
at Cycle No.          0.00  of Load Step No.   10
Step description:
of Block No.     14  of Schedule No.    8511
Crack Size      c =  0.223429

                 FATIGUE CRACK GROWTH ANALYSIS
                -------Modified by FAI-------
              DATE: 05-OCT-98   TIME: 10:16:04
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 11, PSE-W1 SA226 MS, crack in angle (Titl

GEOMETRY
--------
MODEL: TC11-Corner crack in plate or bar (2D)

Plate Thickness, t =    0.1250
  "   Width, W     =    1.4440
Hole Diameter, D   =    0.1600
Hole-Center-to-Edge Dist., B =    0.3100
2ND AREA, AREATC11 =    0.9200
2ND M. INERTIA =    0.3700
2ND C.G. =   -0.1700

FLAW SIZE:

c   (init.) =  0.8400E-01


MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl: UTS  :  YS  : K1e  : K1c  :  Ak : Bk  :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 : 74.0: 65.0: 27.0: 27.0: 1.00: 1.00:  0.125: 51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
: No.:     C      :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :            :     :    :    :       :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:
```

MODEL: TC11

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0: -1.0000
Scale Factor for Stress S3: -1.0000

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 3.8400
Scale Factor for Stress S3: 9.6200

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 3.8400
Scale Factor for Stress S3: 9.6200

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 3.8400
Scale Factor for Stress S3: 9.6200

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 2.9000
Scale Factor for Stress S3: 7.2500

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

3:	1:	0.01 :	0.54:	1.46:	0.54:	1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	9.57 :	0.60:	1.20:	0.60:	1.20:
2:	1:	1.14 :	0.40:	1.40:	0.40:	1.40:
3:	1:	0.57 :	0.30:	1.50:	0.30:	1.50:
4:	1:	0.11 :	0.10:	1.70:	0.10:	1.70:
5:	1:	0.02 :	-0.10:	1.90:	-0.10:	1.90:
6:	1:	0.01 :	-0.30:	2.10:	-0.30:	2.10:
7:	1:	0.00 :	-0.50:	2.30:	-0.50:	2.30:
8:	1:	0.00 :	-0.70:	2.50:	-0.70:	2.50:
9:	1:	0.00 :	-0.90:	2.70:	-0.90:	2.70:
10:	1:	0.00 :	-1.10:	2.90:	-1.10:	2.90:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	19.14 :	0.60:	1.20:	0.60:	1.20:
2:	1:	2.29 :	0.40:	1.40:	0.40:	1.40:
3:	1:	1.14 :	0.30:	1.50:	0.30:	1.50:
4:	1:	0.23 :	0.10:	1.70:	0.10:	1.70:
5:	1:	0.04 :	-0.10:	1.90:	-0.10:	1.90:
6:	1:	0.01 :	-0.30:	2.10:	-0.30:	2.10:
7:	1:	0.00 :	-0.50:	2.30:	-0.50:	2.30:
8:	1:	0.00 :	-0.70:	2.50:	-0.70:	2.50:
9:	1:	0.00 :	-0.90:	2.70:	-0.90:	2.70:
10:	1:	0.00 :	-1.10:	2.90:	-1.10:	2.90:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	38.29 :	0.60:	1.20:	0.60:	1.20:
2:	1:	4.57 :	0.40:	1.40:	0.40:	1.40:
3:	1:	2.29 :	0.30:	1.50:	0.30:	1.50:
4:	1:	0.46 :	0.10:	1.70:	0.10:	1.70:
5:	1:	0.08 :	-0.10:	1.90:	-0.10:	1.90:
6:	1:	0.02 :	-0.30:	2.10:	-0.30:	2.10:
7:	1:	0.01 :	-0.50:	2.30:	-0.50:	2.30:
8:	1:	0.00 :	-0.70:	2.50:	-0.70:	2.50:
9:	1:	0.00 :	-0.90:	2.70:	-0.90:	2.70:
10:	1:	0.00 :	-1.10:	2.90:	-1.10:	2.90:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	-0.70	-1.30	-0.70	-1.30
2	1	0.09	-0.60	-1.40	-0.60	-1.40
3	1	0.01	-0.54	-1.46	-0.54	-1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	2.30	4.61	5.77	11.54
2	1	1.14	1.54	5.38	3.85	13.47
3	1	0.57	1.15	5.76	2.89	14.43
4	1	0.11	0.38	6.53	0.96	16.35
5	1	0.02	-0.38	7.30	-0.96	18.28
6	1	0.01	-1.15	8.06	-2.89	20.20
7	1	0.00	-1.92	8.83	-4.81	22.13
8	1	0.00	-2.69	9.60	-6.73	24.05
9	1	0.00	-3.46	10.37	-8.66	25.97
10	1	0.00	-4.22	11.14	-10.58	27.90

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	2.30	4.61	5.77	11.54
2	1	2.29	1.54	5.38	3.85	13.47
3	1	1.14	1.15	5.76	2.89	14.43
4	1	0.23	0.38	6.53	0.96	16.35
5	1	0.04	-0.38	7.30	-0.96	18.28
6	1	0.01	-1.15	8.06	-2.89	20.20
7	1	0.00	-1.92	8.83	-4.81	22.13
8	1	0.00	-2.69	9.60	-6.73	24.05
9	1	0.00	-3.46	10.37	-8.66	25.97
10	1	0.00	-4.22	11.14	-10.58	27.90

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	2.30	4.61	5.77	11.54
2	1	4.57	1.54	5.38	3.85	13.47
3	1	2.29	1.15	5.76	2.89	14.43
4	1	0.46	0.38	6.53	0.96	16.35
5	1	0.08	-0.38	7.30	-0.96	18.28
6	1	0.02	-1.15	8.06	-2.89	20.20
7	1	0.01	-1.92	8.83	-4.81	22.13
8	1	0.00	-2.69	9.60	-6.73	24.05
9	1	0.00	-3.46	10.37	-8.66	25.97
10	1	0.00	-4.22	11.14	-10.58	27.90

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	2.90	2.93	7.25	7.32
2	1	0.44	2.35	3.07	5.87	7.69
3	1	0.22	1.80	3.25	4.50	8.12
4	1	0.06	1.25	3.42	3.04	8.55
5	1	0.00	0.67	3.60	1.67	8.99
6	1	0.00	0.12	3.77	0.29	9.43

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
ANALYSIS RESULTS:
-----------------


 Schedl     Block              Final Flaw Size             K max
                    Step              c                     c-tip
   200        15                  0.087272               4.088742
   400        15                  0.090593               4.104193
   600        15                  0.093970               4.121803
   800        15                  0.097414               4.141785
  1000        15                  0.100934               4.164397
  1200        15                  0.104542               4.189959
  1400        15                  0.108252               4.218869
  1600        15                  0.112079               4.251628
  1800        15                  0.116043               4.288878
  2000        15                  0.120167               4.331454
  2200        15                  0.124482               4.380469
  2400        15                  0.129025               4.437439
  2600        15                  0.133846               4.504503
  2800        15                  0.139013               4.584798
  3000        15                  0.144625               4.683172
  3200        15                  0.150827               4.807655
  3400        15                  0.157863               4.972908
  3600        15                  0.166183               5.209977
  3800        15                  0.176817               5.603924
  4000        15                  0.193607               6.590056

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     52.19     K ref =     0.000     K cr =     51.83
at Cycle No.           0.00  of Load Step No.   10
Step description:
of Block No.       5  of Schedule No.    4102
Crack Size      c =  0.225393

                  FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
               DATE: 05-OCT-98    TIME: 10:20:13
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 11, PSE-W1 SA226 MS, crack in cap (Title)

GEOMETRY
--------
MODEL: TC11-Corner crack in plate or bar (2D)

Plate Thickness, t =     0.1250
  "   Width, W      =     3.0000
Hole Diameter, D    =     0.1600
Hole-Center-to-Edge Dist., B =     0.3100
2ND AREA, AREATC11 =     0.7350
2ND M. INERTIA =     0.2580
2ND C.G. =     1.4520

FLAW SIZE:

c   (init.) =  0.8800E-01
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
MATERIAL
--------

MATL 1:
        1        2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 : 74.0: 65.0: 27.0: 27.0: 1.00: 1.00:  0.125:  51.8:       :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC11

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S3:    6.6000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S3:    6.6000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S3:    6.6000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.5000
Scale Factor for Stress S3:    4.9700

Total No. of Blocks in Schedule =     15

   Block Number and Case Correspondences
 Block Number                    Block Case No.
From   -   To
    1   -     1                          1
    2   -     2                          2
    3   -     3                          5
    4   -     4                          1
    5   -     5                          3
    6   -     6                          5
    7   -     7                          1
    8   -     8                          3
    9   -     9                          5
   10   -    10                          1
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
11   -   11                        3
12   -   12                        5
13   -   13                        1
14   -   14                        4
15   -   15                        5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :       S0          :        S3          :
 T  : A:    OF        :                   :                    :
 E  : T:  FATIGUE     :                   :                    :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:    0.70:     1.30:
   2: 1:         0.09 :    0.60:     1.40:    0.60:     1.40:
   3: 1:         0.01 :    0.54:     1.46:    0.54:     1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER      :       S0          :        S3          :
 T  : A:    OF        :                   :                    :
 E  : T:  FATIGUE     :                   :                    :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         9.57 :    0.60:     1.20:    0.60:     1.20:
   2: 1:         1.14 :    0.40:     1.40:    0.40:     1.40:
   3: 1:         0.57 :    0.30:     1.50:    0.30:     1.50:
   4: 1:         0.11 :    0.10:     1.70:    0.10:     1.70:
   5: 1:         0.02 :   -0.10:     1.90:   -0.10:     1.90:
   6: 1:         0.01 :   -0.30:     2.10:   -0.30:     2.10:
   7: 1:         0.00 :   -0.50:     2.30:   -0.50:     2.30:
   8: 1:         0.00 :   -0.70:     2.50:   -0.70:     2.50:
   9: 1:         0.00 :   -0.90:     2.70:   -0.90:     2.70:
  10: 1:         0.00 :   -1.10:     2.90:   -1.10:     2.90:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S  : M:  NUMBER      :       S0          :        S3          :
 T  : A:    OF        :                   :                    :
 E  : T:  FATIGUE     :                   :                    :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        19.14 :    0.60:     1.20:    0.60:     1.20:
   2: 1:         2.29 :    0.40:     1.40:    0.40:     1.40:
   3: 1:         1.14 :    0.30:     1.50:    0.30:     1.50:
   4: 1:         0.23 :    0.10:     1.70:    0.10:     1.70:
   5: 1:         0.04 :   -0.10:     1.90:   -0.10:     1.90:
   6: 1:         0.01 :   -0.30:     2.10:   -0.30:     2.10:
   7: 1:         0.00 :   -0.50:     2.30:   -0.50:     2.30:
   8: 1:         0.00 :   -0.70:     2.50:   -0.70:     2.50:
   9: 1:         0.00 :   -0.90:     2.70:   -0.90:     2.70:
  10: 1:         0.00 :   -1.10:     2.90:   -1.10:     2.90:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
 S  : M:  NUMBER      :       S0          :        S3          :
 T  : A:    OF        :                   :                    :
 E  : T:  FATIGUE     :                   :                    :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)    :
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

1	1	38.29	0.60	1.20	0.60	1.20
2	1	4.57	0.40	1.40	0.40	1.40
3	1	2.29	0.30	1.50	0.30	1.50
4	1	0.46	0.10	1.70	0.10	1.70
5	1	0.08	-0.10	1.90	-0.10	1.90
6	1	0.02	-0.30	2.10	-0.30	2.10
7	1	0.01	-0.50	2.30	-0.50	2.30
8	1	0.00	-0.70	2.50	-0.70	2.50
9	1	0.00	-0.90	2.70	-0.90	2.70
10	1	0.00	-1.10	2.90	-1.10	2.90

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	-0.70	-1.30	-0.70	-1.30
2	1	0.09	-0.60	-1.40	-0.60	-1.40
3	1	0.01	-0.54	-1.46	-0.54	-1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	2.78	5.57	3.96	7.92
2	1	1.14	1.86	6.50	2.64	9.24
3	1	0.57	1.39	6.96	1.98	9.90
4	1	0.11	0.46	7.89	0.66	11.22
5	1	0.02	-0.46	8.82	-0.66	12.54
6	1	0.01	-1.39	9.74	-1.98	13.86

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

7:	1:	0.00 :	-2.32:	10.67:	-3.30:	15.18:
8:	1:	0.00 :	-3.25:	11.60:	-4.62:	16.50:
9:	1:	0.00 :	-4.18:	12.53:	-5.94:	17.82:
10:	1:	0.00 :	-5.10:	13.46:	-7.26:	19.14:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	19.14 :	2.78:	5.57:	3.96:	7.92:
2:	1:	2.29 :	1.86:	6.50:	2.64:	9.24:
3:	1:	1.14 :	1.39:	6.96:	1.98:	9.90:
4:	1:	0.23 :	0.46:	7.89:	0.66:	11.22:
5:	1:	0.04 :	-0.46:	8.82:	-0.66:	12.54:
6:	1:	0.01 :	-1.39:	9.74:	-1.98:	13.86:
7:	1:	0.00 :	-2.32:	10.67:	-3.30:	15.18:
8:	1:	0.00 :	-3.25:	11.60:	-4.62:	16.50:
9:	1:	0.00 :	-4.18:	12.53:	-5.94:	17.82:
10:	1:	0.00 :	-5.10:	13.46:	-7.26:	19.14:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	38.29 :	2.78:	5.57:	3.96:	7.92:
2:	1:	4.57 :	1.86:	6.50:	2.64:	9.24:
3:	1:	2.29 :	1.39:	6.96:	1.98:	9.90:
4:	1:	0.46 :	0.46:	7.89:	0.66:	11.22:
5:	1:	0.08 :	-0.46:	8.82:	-0.66:	12.54:
6:	1:	0.02 :	-1.39:	9.74:	-1.98:	13.86:
7:	1:	0.01 :	-2.32:	10.67:	-3.30:	15.18:
8:	1:	0.00 :	-3.25:	11.60:	-4.62:	16.50:
9:	1:	0.00 :	-4.18:	12.53:	-5.94:	17.82:
10:	1:	0.00 :	-5.10:	13.46:	-7.26:	19.14:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STE	MAT	NUMBER OF FATIGUE	S0 (ksi)	S3 (ksi)

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
 P  : L:  CYCLES      :    (t1) :  (t2)     :     (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.28 :     3.50:     3.54:     4.97:     5.02:
   2: 1:        0.44 :     2.83:     3.71:     4.03:     5.27:
   3: 1:        0.22 :     2.17:     3.92:     3.08:     5.57:
   4: 1:        0.06 :     1.50:     4.13:     2.09:     5.86:
   5: 1:        0.00 :     0.81:     4.34:     1.14:     6.16:
   6: 1:        0.00 :     0.14:     4.55:     0.20:     6.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 THROUGH CRACK CASE 11, PSE-
MODEL: TC11

ANALYSIS RESULTS:
-----------------


 Schedl    Block          Final Flaw Size            K max
                 Step          c                     c-tip
    200      15              0.091784              4.235073
    400      15              0.095703              4.271785
    600      15              0.099776              4.312894
    800      15              0.104029              4.359204
   1000      15              0.108492              4.411764
   1200      15              0.113205              4.471979
   1400      15              0.118217              4.541795
   1600      15              0.123597              4.624001
   1800      15              0.129440              4.722792
   2000      15              0.135888              4.844865
   2200      15              0.143163              5.001846
   2400      15              0.151651              5.216501
   2600      15              0.162150              5.543052
   2800      15              0.176885              6.171739

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     53.04      K ref =     0.000     K cr =     51.83
at Cycle No.           0.00  of Load Step No.     7
Step description:
of Block No.      11  of Schedule No.    2993
Crack Size      c =  0.226371

                 FATIGUE CRACK GROWTH ANALYSIS
                -------Modified by FAI-------
               DATE: 05-OCT-98    TIME: 10:20:46
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC12, PSE-W1 SA226 Main Spar Angle WS99       (Title)

GEOMETRY
--------
MODEL: TC12-Corner crack from hole in plate (2D)

Plate Thickness, t =     0.1250
  "   Width, W     =     1.4400
Additional Area, AREA3 =     0.9200
Add Area cg dist in y, F3 =     0.2940
Add Area cg dist in x, G3 =   -0.1700
Add Area Ix, RIX =     0.1830
Add Area Iy, RIY =     0.3700
Moement      , RM =     0.0000
```

```
FLAW SIZE:

c   (init.) =  0.3950



MATERIAL
--------

MATL 1:
       1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC12

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    4.9100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    4.9100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    4.9100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.7000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Total No. of Blocks in Schedule =    15
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.70	1.30	-0.30	0.30
2	1	0.09	0.60	1.40	-0.40	0.40
3	1	0.01	0.54	1.46	-0.46	0.46

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	1.90	-0.30	0.30	0.00	0.00
2	1	0.09	-0.40	0.40	0.00	0.00
3	1	0.01	-0.46	0.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	9.57	0.60	1.20	-0.30	0.30
2	1	1.14	0.40	1.40	-0.50	0.50
3	1	0.57	0.30	1.50	-0.60	0.60
4	1	0.11	0.10	1.70	-0.80	0.80
5	1	0.02	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	9.57	-0.30	0.30	0.00	0.00
2	1	1.14	-0.50	0.50	0.00	0.00
3	1	0.57	-0.60	0.60	0.00	0.00
4	1	0.11	-0.80	0.80	0.00	0.00

5	1	0.02	-1.00	1.00	0.00	0.00
6	1	0.01	-1.20	1.20	0.00	0.00
7	1	0.00	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.60	1.20	-0.30	0.30
2	1	2.29	0.40	1.40	-0.50	0.50
3	1	1.14	0.30	1.50	-0.60	0.60
4	1	0.23	0.10	1.70	-0.80	0.80
5	1	0.04	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	19.14	-0.30	0.30	0.00	0.00
2	1	2.29	-0.50	0.50	0.00	0.00
3	1	1.14	-0.60	0.60	0.00	0.00
4	1	0.23	-0.80	0.80	0.00	0.00
5	1	0.04	-1.00	1.00	0.00	0.00
6	1	0.01	-1.20	1.20	0.00	0.00
7	1	0.00	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.60	1.20	-0.30	0.30
2	1	4.57	0.40	1.40	-0.50	0.50
3	1	2.29	0.30	1.50	-0.60	0.60
4	1	0.46	0.10	1.70	-0.80	0.80
5	1	0.08	-0.10	1.90	-1.00	1.00
6	1	0.02	-0.30	2.10	-1.20	1.20
7	1	0.01	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)

1:	1:	38.29	-0.30	0.30	0.00	0.00
2:	1:	4.57	-0.50	0.50	0.00	0.00
3:	1:	2.29	-0.60	0.60	0.00	0.00
4:	1:	0.46	-0.80	0.80	0.00	0.00
5:	1:	0.08	-1.00	1.00	0.00	0.00
6:	1:	0.02	-1.20	1.20	0.00	0.00
7:	1:	0.01	-1.40	1.40	0.00	0.00
8:	1:	0.00	-1.60	1.60	0.00	0.00
9:	1:	0.00	-1.80	1.80	0.00	0.00
10:	1:	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	0.28	1.00	1.01	1.00	1.01
2:	1:	0.44	0.81	1.06	0.81	1.06
3:	1:	0.22	0.62	1.12	0.62	1.12
4:	1:	0.06	0.43	1.18	0.42	1.18
5:	1:	0.00	0.23	1.24	0.23	1.24
6:	1:	0.00	0.04	1.30	0.04	1.30

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1:	1:	0.28	1.00	1.00	0.00	0.00
2:	1:	0.44	0.81	1.06	0.00	0.00
3:	1:	0.22	0.62	1.12	0.00	0.00
4:	1:	0.06	0.43	1.18	0.00	0.00
5:	1:	0.00	0.23	1.24	0.00	0.00
6:	1:	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	1.90	-0.70	-1.30	0.00	0.00
2:	1:	0.09	-0.60	-1.40	0.00	0.00
3:	1:	0.01	-0.54	-1.46	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	1.90	0.00	0.00	0.00	0.00
2:	1:	0.09	0.00	0.00	0.00	0.00
3:	1:	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

(Kmax less than KIscc): NOT SET

TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	2.95	5.89	0.00	0.00
2	1	1.14	1.96	6.87	0.00	0.00
3	1	0.57	1.47	7.37	0.00	0.00
4	1	0.11	0.49	8.35	0.00	0.00
5	1	0.02	-0.49	9.33	0.00	0.00
6	1	0.01	-1.47	10.31	0.00	0.00
7	1	0.00	-2.45	11.29	0.00	0.00
8	1	0.00	-3.44	12.28	0.00	0.00
9	1	0.00	-4.42	13.26	0.00	0.00
10	1	0.00	-5.40	14.24	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	0.00	0.00	0.00	0.00
2	1	1.14	0.00	0.00	0.00	0.00
3	1	0.57	0.00	0.00	0.00	0.00
4	1	0.11	0.00	0.00	0.00	0.00
5	1	0.02	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	2.95	5.89	0.00	0.00
2	1	2.29	1.96	6.87	0.00	0.00
3	1	1.14	1.47	7.37	0.00	0.00
4	1	0.23	0.49	8.35	0.00	0.00
5	1	0.04	-0.49	9.33	0.00	0.00
6	1	0.01	-1.47	10.31	0.00	0.00
7	1	0.00	-2.45	11.29	0.00	0.00
8	1	0.00	-3.44	12.28	0.00	0.00
9	1	0.00	-4.42	13.26	0.00	0.00
10	1	0.00	-5.40	14.24	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)

1:	1:	19.14 :	0.00:	0.00:	0.00:	0.00:
2:	1:	2.29 :	0.00:	0.00:	0.00:	0.00:
3:	1:	1.14 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.23 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.04 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:
7:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
8:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
9:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
10:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	38.29 :	2.95:	5.89:	0.00:	0.00:
2:	1:	4.57 :	1.96:	6.87:	0.00:	0.00:
3:	1:	2.29 :	1.47:	7.37:	0.00:	0.00:
4:	1:	0.46 :	0.49:	8.35:	0.00:	0.00:
5:	1:	0.08 :	-0.49:	9.33:	0.00:	0.00:
6:	1:	0.02 :	-1.47:	10.31:	0.00:	0.00:
7:	1:	0.01 :	-2.45:	11.29:	0.00:	0.00:
8:	1:	0.00 :	-3.44:	12.28:	0.00:	0.00:
9:	1:	0.00 :	-4.42:	13.26:	0.00:	0.00:
10:	1:	0.00 :	-5.40:	14.24:	0.00:	0.00:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	38.29 :	0.00:	0.00:	0.00:	0.00:
2:	1:	4.57 :	0.00:	0.00:	0.00:	0.00:
3:	1:	2.29 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.46 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.08 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.02 :	0.00:	0.00:	0.00:	0.00:
7:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:
8:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
9:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
10:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28 :	3.70:	3.74:	0.00:	0.00:

```
  2: 1:         0.44 :    3.00:     3.92:     0.00:     0.00:
  3: 1:         0.22 :    2.29:     4.14:     0.00:     0.00:
  4: 1:         0.06 :    1.59:     4.37:     0.00:     0.00:
  5: 1:         0.00 :    0.85:     4.59:     0.00:     0.00:
  6: 1:         0.00 :    0.15:     4.81:     0.00:     0.00:
S  : M:  NUMBER      :       S2          :        S          :
T  : A:    OF        :                   :                   :
E  : T:  FATIGUE     :     (ksi)         :      (ksi)        :
P  : L:  CYCLES      :   (t1)  :  (t2)   :   (t1)  :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         0.28 :    0.00:     0.00:     0.00:     0.00:
  2: 1:         0.44 :    0.00:     0.00:     0.00:     0.00:
  3: 1:         0.22 :    0.00:     0.00:     0.00:     0.00:
  4: 1:         0.06 :    0.00:     0.00:     0.00:     0.00:
  5: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:
  6: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

ANALYSIS RESULTS:
-----------------
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
100	15		0.406304	6.516847
200	15		0.418675	6.665259
300	15		0.432320	6.831210
400	15		0.447515	7.018959
500	15		0.464636	7.234459
600	15		0.484216	7.486369
700	15		0.507043	7.787943
800	15		0.534365	8.160885
900	15		0.568323	8.644261
1000	15		0.613117	9.319134
1100	15		0.679004	10.400394
1200	15		0.807711	12.902525

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =    51.86     K ref =    0.000     K cr =    51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.     11  of Schedule No.    1244
Crack Size      c =  0.979875

                  FATIGUE CRACK GROWTH ANALYSIS
                  -------Modified by FAI-------
                DATE: 05-OCT-98   TIME: 10:21:01
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC12, PSE-W1 SA226 Main Spar Cap WS99       (Title)

GEOMETRY
--------
MODEL: TC12-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
  "   Width, W     =    3.0000
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

Additional Area, AREA3 = 0.7350
Add Area cg dist in y, F3 = 0.5380
Add Area cg dist in x, G3 = 1.4520
Add Area Ix, RIX = 0.1360
Add Area Iy, RIY = 0.2580
Moement , RM = 0.0000

FLAW SIZE:

c (init.) = 0.3950

MATERIAL

MATL 1:
1 2014T6511 EXTRUSION T-L

Material Properties:

Matl: No.:	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	74.0	65.0	27.0	27.0	1.00	1.00	0.125	51.8	

Matl: No.:	C	n	p	q	DKo	Rcl	Alpha	Smax/ SIGo
	Crack Growth Eqn Constants							
1	0.200D-08	3.700	0.50	1.00	2.70	0.70	5.84	1.00

MODEL: TC12

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0: -1.0000
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S2: 0.0000

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 5.3700
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S2: 0.0000

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 5.3700
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S2: 0.0000

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 5.3700
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S2: 0.0000

Stress Scaling Factors for Block Case: 5

```
Scale Factor for Stress S0:    4.0500
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Total No. of Blocks in Schedule =     15

   Block Number and Case Correspondences
 Block Number                   Block Case No.
From   -   To
   1   -     1                          1
   2   -     2                          2
   3   -     3                          5
   4   -     4                          1
   5   -     5                          3
   6   -     6                          5
   7   -     7                          1
   8   -     8                          3
   9   -     9                          5
  10   -    10                          1
  11   -    11                          3
  12   -    12                          5
  13   -    13                          1
  14   -    14                          4
  15   -    15                          5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :        S0         :        S1         :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :                   :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        1.90  :   0.70:     1.30:    -0.30:     0.30:
   2: 1:        0.09  :   0.60:     1.40:    -0.40:     0.40:
   3: 1:        0.01  :   0.54:     1.46:    -0.46:     0.46:
 S  : M:  NUMBER      :        S2         :        S          :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :                   :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        1.90  :  -0.30:     0.30:     0.00:     0.00:
   2: 1:        0.09  :  -0.40:     0.40:     0.00:     0.00:
   3: 1:        0.01  :  -0.46:     0.46:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER      :        S0         :        S1         :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :                   :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        9.57  :   0.60:     1.20:    -0.30:     0.30:
   2: 1:        1.14  :   0.40:     1.40:    -0.50:     0.50:
   3: 1:        0.57  :   0.30:     1.50:    -0.60:     0.60:
   4: 1:        0.11  :   0.10:     1.70:    -0.80:     0.80:
   5: 1:        0.02  :  -0.10:     1.90:    -1.00:     1.00:
   6: 1:        0.01  :  -0.30:     2.10:    -1.20:     1.20:
   7: 1:        0.00  :  -0.50:     2.30:    -1.40:     1.40:
   8: 1:        0.00  :  -0.70:     2.50:    -1.60:     1.60:
   9: 1:        0.00  :  -0.90:     2.70:    -1.80:     1.80:
  10: 1:        0.00  :  -1.10:     2.90:    -2.00:     2.00:
 S  : M:  NUMBER      :        S2         :        S          :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :                   :                   :
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	9.57	-0.30:	0.30:	0.00:	0.00:
2:	1:	1.14	-0.50:	0.50:	0.00:	0.00:
3:	1:	0.57	-0.60:	0.60:	0.00:	0.00:
4:	1:	0.11	-0.80:	0.80:	0.00:	0.00:
5:	1:	0.02	-1.00:	1.00:	0.00:	0.00:
6:	1:	0.01	-1.20:	1.20:	0.00:	0.00:
7:	1:	0.00	-1.40:	1.40:	0.00:	0.00:
8:	1:	0.00	-1.60:	1.60:	0.00:	0.00:
9:	1:	0.00	-1.80:	1.80:	0.00:	0.00:
10:	1:	0.00	-2.00:	2.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	19.14	0.60:	1.20:	-0.30:	0.30:
2:	1:	2.29	0.40:	1.40:	-0.50:	0.50:
3:	1:	1.14	0.30:	1.50:	-0.60:	0.60:
4:	1:	0.23	0.10:	1.70:	-0.80:	0.80:
5:	1:	0.04	-0.10:	1.90:	-1.00:	1.00:
6:	1:	0.01	-0.30:	2.10:	-1.20:	1.20:
7:	1:	0.00	-0.50:	2.30:	-1.40:	1.40:
8:	1:	0.00	-0.70:	2.50:	-1.60:	1.60:
9:	1:	0.00	-0.90:	2.70:	-1.80:	1.80:
10:	1:	0.00	-1.10:	2.90:	-2.00:	2.00:

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1:	1:	19.14	-0.30:	0.30:	0.00:	0.00:
2:	1:	2.29	-0.50:	0.50:	0.00:	0.00:
3:	1:	1.14	-0.60:	0.60:	0.00:	0.00:
4:	1:	0.23	-0.80:	0.80:	0.00:	0.00:
5:	1:	0.04	-1.00:	1.00:	0.00:	0.00:
6:	1:	0.01	-1.20:	1.20:	0.00:	0.00:
7:	1:	0.00	-1.40:	1.40:	0.00:	0.00:
8:	1:	0.00	-1.60:	1.60:	0.00:	0.00:
9:	1:	0.00	-1.80:	1.80:	0.00:	0.00:
10:	1:	0.00	-2.00:	2.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	38.29	0.60:	1.20:	-0.30:	0.30:
2:	1:	4.57	0.40:	1.40:	-0.50:	0.50:
3:	1:	2.29	0.30:	1.50:	-0.60:	0.60:
4:	1:	0.46	0.10:	1.70:	-0.80:	0.80:
5:	1:	0.08	-0.10:	1.90:	-1.00:	1.00:
6:	1:	0.02	-0.30:	2.10:	-1.20:	1.20:
7:	1:	0.01	-0.50:	2.30:	-1.40:	1.40:
8:	1:	0.00	-0.70:	2.50:	-1.60:	1.60:

STEP	MAT	NUMBER OF FATIGUE CYCLES	(t1)	(t2)	(t1)	(t2)
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	38.29	-0.30	0.30	0.00	0.00
2	1	4.57	-0.50	0.50	0.00	0.00
3	1	2.29	-0.60	0.60	0.00	0.00
4	1	0.46	-0.80	0.80	0.00	0.00
5	1	0.08	-1.00	1.00	0.00	0.00
6	1	0.02	-1.20	1.20	0.00	0.00
7	1	0.01	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)

1:	1:	1.90 :	0.00:	0.00:	0.00:	0.00:
2:	1:	0.09 :	0.00:	0.00:	0.00:	0.00:
3:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	9.57 :	3.22:	6.44:	0.00:	0.00:
2:	1:	1.14 :	2.15:	7.52:	0.00:	0.00:
3:	1:	0.57 :	1.61:	8.05:	0.00:	0.00:
4:	1:	0.11 :	0.54:	9.13:	0.00:	0.00:
5:	1:	0.02 :	-0.54:	10.20:	0.00:	0.00:
6:	1:	0.01 :	-1.61:	11.28:	0.00:	0.00:
7:	1:	0.00 :	-2.68:	12.35:	0.00:	0.00:
8:	1:	0.00 :	-3.76:	13.43:	0.00:	0.00:
9:	1:	0.00 :	-4.83:	14.50:	0.00:	0.00:
10:	1:	0.00 :	-5.91:	15.57:	0.00:	0.00:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	9.57 :	0.00:	0.00:	0.00:	0.00:
2:	1:	1.14 :	0.00:	0.00:	0.00:	0.00:
3:	1:	0.57 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.11 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.02 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:
7:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
8:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
9:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
10:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	19.14 :	3.22:	6.44:	0.00:	0.00:
2:	1:	2.29 :	2.15:	7.52:	0.00:	0.00:
3:	1:	1.14 :	1.61:	8.05:	0.00:	0.00:
4:	1:	0.23 :	0.54:	9.13:	0.00:	0.00:
5:	1:	0.04 :	-0.54:	10.20:	0.00:	0.00:
6:	1:	0.01 :	-1.61:	11.28:	0.00:	0.00:
7:	1:	0.00 :	-2.68:	12.35:	0.00:	0.00:
8:	1:	0.00 :	-3.76:	13.43:	0.00:	0.00:

```
  9: 1:        0.00 :   -4.83:    14.50:    0.00:     0.00:
 10: 1:        0.00 :   -5.91:    15.57:    0.00:     0.00:
S   : M:  NUMBER    :       S2          :      S          :
T   : A:  . OF      :                   :                 :
E   : T:  FATIGUE   :     (ksi)         :     (ksi)       :
P   : L:  CYCLES    :   (t1) :  (t2)    :   (t1) :  (t2)  :
----:--:------------:---------:---------:---------:---------:
  1: 1:       19.14 :    0.00:     0.00:    0.00:     0.00:
  2: 1:        2.29 :    0.00:     0.00:    0.00:     0.00:
  3: 1:        1.14 :    0.00:     0.00:    0.00:     0.00:
  4: 1:        0.23 :    0.00:     0.00:    0.00:     0.00:
  5: 1:        0.04 :    0.00:     0.00:    0.00:     0.00:
  6: 1:        0.01 :    0.00:     0.00:    0.00:     0.00:
  7: 1:        0.00 :    0.00:     0.00:    0.00:     0.00:
  8: 1:        0.00 :    0.00:     0.00:    0.00:     0.00:
  9: 1:        0.00 :    0.00:     0.00:    0.00:     0.00:
 10: 1:        0.00 :    0.00:     0.00:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER     :       S0          :       S1          :
T   : A:    OF       :                   :                   :
E   : T:  FATIGUE    :     (ksi)         :     (ksi)         :
P   : L:  CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        38.29 :    3.22:     6.44:    0.00:     0.00:
  2: 1:         4.57 :    2.15:     7.52:    0.00:     0.00:
  3: 1:         2.29 :    1.61:     8.05:    0.00:     0.00:
  4: 1:         0.46 :    0.54:     9.13:    0.00:     0.00:
  5: 1:         0.08 :   -0.54:    10.20:    0.00:     0.00:
  6: 1:         0.02 :   -1.61:    11.28:    0.00:     0.00:
  7: 1:         0.01 :   -2.68:    12.35:    0.00:     0.00:
  8: 1:         0.00 :   -3.76:    13.43:    0.00:     0.00:
  9: 1:         0.00 :   -4.83:    14.50:    0.00:     0.00:
 10: 1:         0.00 :   -5.91:    15.57:    0.00:     0.00:
S   : M:  NUMBER     :       S2          :       S           :
T   : A:    OF       :                   :                   :
E   : T:  FATIGUE    :     (ksi)         :     (ksi)         :
P   : L:  CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        38.29 :    0.00:     0.00:    0.00:     0.00:
  2: 1:         4.57 :    0.00:     0.00:    0.00:     0.00:
  3: 1:         2.29 :    0.00:     0.00:    0.00:     0.00:
  4: 1:         0.46 :    0.00:     0.00:    0.00:     0.00:
  5: 1:         0.08 :    0.00:     0.00:    0.00:     0.00:
  6: 1:         0.02 :    0.00:     0.00:    0.00:     0.00:
  7: 1:         0.01 :    0.00:     0.00:    0.00:     0.00:
  8: 1:         0.00 :    0.00:     0.00:    0.00:     0.00:
  9: 1:         0.00 :    0.00:     0.00:    0.00:     0.00:
 10: 1:         0.00 :    0.00:     0.00:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
S   : M:  NUMBER      :        S0          :         S1         :
T   : A:    OF        :                    :                    :
E   : T:  FATIGUE     :      (ksi)         :       (ksi)        :
P   : L:  CYCLES      :   (t1) :   (t2)    :    (t1) :   (t2)   :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         0.28 :    4.05:     4.09:     0.00:     0.00:
   2: 1:         0.44 :    3.28:     4.29:     0.00:     0.00:
   3: 1:         0.22 :    2.51:     4.54:     0.00:     0.00:
   4: 1:         0.06 :    1.74:     4.78:     0.00:     0.00:
   5: 1:         0.00 :    0.93:     5.02:     0.00:     0.00:
   6: 1:         0.00 :    0.16:     5.26:     0.00:     0.00:
S   : M:  NUMBER      :        S2          :         S          :
T   : A:    OF        :                    :                    :
E   : T:  FATIGUE     :      (ksi)         :       (ksi)        :
P   : L:  CYCLES      :   (t1) :   (t2)    :    (t1) :   (t2)   :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         0.28 :    0.00:     0.00:     0.00:     0.00:
   2: 1:         0.44 :    0.00:     0.00:     0.00:     0.00:
   3: 1:         0.22 :    0.00:     0.00:     0.00:     0.00:
   4: 1:         0.06 :    0.00:     0.00:     0.00:     0.00:
   5: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:
   6: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W1 SA226 Main Spa
MODEL: TC12

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
100	15		0.407895	6.721813
200	15		0.421819	6.850195
300	15		0.436918	6.988788
400	15		0.453375	7.139245
500	15		0.471413	7.303647
600	15		0.491316	7.484665
700	15		0.513452	7.685799
800	15		0.538304	7.911754
900	15		0.566529	8.169060
1000	15		0.599053	8.467120
1100	15		0.637240	8.820165
1200	15		0.683221	9.251129
1300	15		0.740612	9.800380
1400	15		0.816328	10.548807
1500	15		0.926522	11.697429
1600	15		1.128692	14.037365

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max = 51.88 K ref = 0.000 K cr = 51.83
at the very beginning of Load Step No. 10
Step description:
of Block No. 14 of Schedule No. 1650
Crack Size c = 1.38247

FATIGUE CRACK GROWTH ANALYSIS
-------Modified by FAI-------
DATE: 05-OCT-98 TIME: 10:21:17
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
PROBLEM TITLE
-------------
TC2, PSE-W1 SA226 Main Spar Angle WS99       (Title)

GEOMETRY
--------
MODEL: TC02-Single edge through crack.

Plate Thickness, t =    0.1250
  "   Width, W     =    1.4400

FLAW SIZE:

c   (init.) =  0.3950




MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS   :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :       :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    4.9100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    4.9100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    4.9100
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.7000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                   Block Case No.
From   -   To
   1   -     1                           1
   2   -     2                           2
   3   -     3                           5
   4   -     4                           1
   5   -     5                           3
   6   -     6                           5
   7   -     7                           1
   8   -     8                           3
   9   -     9                           5
  10   -    10                           1
  11   -    11                           3
  12   -    12                           5
  13   -    13                           1
  14   -    14                           4
  15   -    15                           5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :        S0          :        S1          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :                    :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:    -0.30:     0.30:
   2: 1:         0.09 :    0.60:     1.40:    -0.40:     0.40:
   3: 1:         0.01 :    0.54:     1.46:    -0.46:     0.46:
 S   : M:  NUMBER      :        S2          :        S           :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :                    :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :   -0.30:     0.30:     0.00:     0.00:
   2: 1:         0.09 :   -0.40:     0.40:     0.00:     0.00:
   3: 1:         0.01 :   -0.46:     0.46:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                         -------

BLOCK CASE NO.  2
 S   : M:  NUMBER      :        S0          :        S1          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :                    :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :    0.60:     1.20:    -0.30:     0.30:
   2: 1:         1.14 :    0.40:     1.40:    -0.50:     0.50:
   3: 1:         0.57 :    0.30:     1.50:    -0.60:     0.60:
   4: 1:         0.11 :    0.10:     1.70:    -0.80:     0.80:
   5: 1:         0.02 :   -0.10:     1.90:    -1.00:     1.00:
   6: 1:         0.01 :   -0.30:     2.10:    -1.20:     1.20:
   7: 1:         0.00 :   -0.50:     2.30:    -1.40:     1.40:
   8: 1:         0.00 :   -0.70:     2.50:    -1.60:     1.60:
   9: 1:         0.00 :   -0.90:     2.70:    -1.80:     1.80:
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

STEP	MAT	NUMBER OF FATIGUE CYCLES	(t1)	(t2)	(t1)	(t2)
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	9.57	-0.30	0.30	0.00	0.00
2	1	1.14	-0.50	0.50	0.00	0.00
3	1	0.57	-0.60	0.60	0.00	0.00
4	1	0.11	-0.80	0.80	0.00	0.00
5	1	0.02	-1.00	1.00	0.00	0.00
6	1	0.01	-1.20	1.20	0.00	0.00
7	1	0.00	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.60	1.20	-0.30	0.30
2	1	2.29	0.40	1.40	-0.50	0.50
3	1	1.14	0.30	1.50	-0.60	0.60
4	1	0.23	0.10	1.70	-0.80	0.80
5	1	0.04	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	19.14	-0.30	0.30	0.00	0.00
2	1	2.29	-0.50	0.50	0.00	0.00
3	1	1.14	-0.60	0.60	0.00	0.00
4	1	0.23	-0.80	0.80	0.00	0.00
5	1	0.04	-1.00	1.00	0.00	0.00
6	1	0.01	-1.20	1.20	0.00	0.00
7	1	0.00	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.60	1.20	-0.30	0.30
2	1	4.57	0.40	1.40	-0.50	0.50
3	1	2.29	0.30	1.50	-0.60	0.60
4	1	0.46	0.10	1.70	-0.80	0.80

5	1	0.08	-0.10	1.90	-1.00	1.00
6	1	0.02	-0.30	2.10	-1.20	1.20
7	1	0.01	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	38.29	-0.30	0.30	0.00	0.00
2	1	4.57	-0.50	0.50	0.00	0.00
3	1	2.29	-0.60	0.60	0.00	0.00
4	1	0.46	-0.80	0.80	0.00	0.00
5	1	0.08	-1.00	1.00	0.00	0.00
6	1	0.02	-1.20	1.20	0.00	0.00
7	1	0.01	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	2.95	5.89	0.00	0.00
2	1	1.14	1.96	6.87	0.00	0.00
3	1	0.57	1.47	7.37	0.00	0.00
4	1	0.11	0.49	8.35	0.00	0.00
5	1	0.02	-0.49	9.33	0.00	0.00
6	1	0.01	-1.47	10.31	0.00	0.00
7	1	0.00	-2.45	11.29	0.00	0.00
8	1	0.00	-3.44	12.28	0.00	0.00
9	1	0.00	-4.42	13.26	0.00	0.00
10	1	0.00	-5.40	14.24	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	0.00	0.00	0.00	0.00
2	1	1.14	0.00	0.00	0.00	0.00
3	1	0.57	0.00	0.00	0.00	0.00
4	1	0.11	0.00	0.00	0.00	0.00
5	1	0.02	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	2.95	5.89	0.00	0.00
2	1	2.29	1.96	6.87	0.00	0.00
3	1	1.14	1.47	7.37	0.00	0.00
4	1	0.23	0.49	8.35	0.00	0.00

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

5	1	0.04	-0.49	9.33	0.00	0.00
6	1	0.01	-1.47	10.31	0.00	0.00
7	1	0.00	-2.45	11.29	0.00	0.00
8	1	0.00	-3.44	12.28	0.00	0.00
9	1	0.00	-4.42	13.26	0.00	0.00
10	1	0.00	-5.40	14.24	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00
2	1	2.29	0.00	0.00	0.00	0.00
3	1	1.14	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.04	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	2.95	5.89	0.00	0.00
2	1	4.57	1.96	6.87	0.00	0.00
3	1	2.29	1.47	7.37	0.00	0.00
4	1	0.46	0.49	8.35	0.00	0.00
5	1	0.08	-0.49	9.33	0.00	0.00
6	1	0.02	-1.47	10.31	0.00	0.00
7	1	0.01	-2.45	11.29	0.00	0.00
8	1	0.00	-3.44	12.28	0.00	0.00
9	1	0.00	-4.42	13.26	0.00	0.00
10	1	0.00	-5.40	14.24	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	38.29	0.00	0.00	0.00	0.00
2	1	4.57	0.00	0.00	0.00	0.00
3	1	2.29	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.08	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.28	3.70	3.74	0.00	0.00
2	1	0.44	3.00	3.92	0.00	0.00
3	1	0.22	2.29	4.14	0.00	0.00
4	1	0.06	1.59	4.37	0.00	0.00
5	1	0.00	0.85	4.59	0.00	0.00
6	1	0.00	0.15	4.81	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	0.00	0.00	0.00	0.00
2	1	0.44	0.00	0.00	0.00	0.00
3	1	0.22	0.00	0.00	0.00	0.00
4	1	0.06	0.00	0.00	0.00	0.00
5	1	0.00	0.00	0.00	0.00	0.00
6	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
100	15		0.437951	9.422768
200	15		0.524720	11.876780

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No. 10
Step description:
of Block No. 14 of Schedule No. 236
Crack Size c = 0.610198

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No. 10
Step description:
of Block No. 11 of Schedule No. 241
Crack Size c = 0.632745

FATIGUE CRACK GROWTH ANALYSIS
-------Modified by FAI-------
DATE: 05-OCT-98 TIME: 10:21:28
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
TC2, PSE-W1 SA226 Main Spar Cap WS99       (Title)

GEOMETRY
--------
MODEL: TC02-Single edge through crack.

Plate Thickness, t =    0.1250
  "   Width, W     =    3.0000

FLAW SIZE:

c   (init.) =  0.3950




MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    5.3700
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    5.3700
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    5.3700
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000
```

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 4.0500
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S2: 0.0000

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.70	1.30	-0.30	0.30
2	1	0.09	0.60	1.40	-0.40	0.40
3	1	0.01	0.54	1.46	-0.46	0.46

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	1.90	-0.30	0.30	0.00	0.00
2	1	0.09	-0.40	0.40	0.00	0.00
3	1	0.01	-0.46	0.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	9.57	0.60	1.20	-0.30	0.30
2	1	1.14	0.40	1.40	-0.50	0.50
3	1	0.57	0.30	1.50	-0.60	0.60
4	1	0.11	0.10	1.70	-0.80	0.80
5	1	0.02	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

S : M: NUMBER : S2 : S :

```
 T  : A:    OF         :                    :                    :
 E  : T:  FATIGUE      :                    :                    :
 P  : L:  CYCLES       :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:---------------:---------:---------:---------:---------:
  1: 1:          9.57 :   -0.30:      0.30:     0.00:      0.00:
  2: 1:          1.14 :   -0.50:      0.50:     0.00:      0.00:
  3: 1:          0.57 :   -0.60:      0.60:     0.00:      0.00:
  4: 1:          0.11 :   -0.80:      0.80:     0.00:      0.00:
  5: 1:          0.02 :   -1.00:      1.00:     0.00:      0.00:
  6: 1:          0.01 :   -1.20:      1.20:     0.00:      0.00:
  7: 1:          0.00 :   -1.40:      1.40:     0.00:      0.00:
  8: 1:          0.00 :   -1.60:      1.60:     0.00:      0.00:
  9: 1:          0.00 :   -1.80:      1.80:     0.00:      0.00:
 10: 1:          0.00 :   -2.00:      2.00:     0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S  : M:  NUMBER       :        S0          :        S1          :
 T  : A:    OF         :                    :                    :
 E  : T:  FATIGUE      :                    :                    :
 P  : L:  CYCLES       :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:---------------:---------:---------:---------:---------:
  1: 1:         19.14 :    0.60:      1.20:    -0.30:      0.30:
  2: 1:          2.29 :    0.40:      1.40:    -0.50:      0.50:
  3: 1:          1.14 :    0.30:      1.50:    -0.60:      0.60:
  4: 1:          0.23 :    0.10:      1.70:    -0.80:      0.80:
  5: 1:          0.04 :   -0.10:      1.90:    -1.00:      1.00:
  6: 1:          0.01 :   -0.30:      2.10:    -1.20:      1.20:
  7: 1:          0.00 :   -0.50:      2.30:    -1.40:      1.40:
  8: 1:          0.00 :   -0.70:      2.50:    -1.60:      1.60:
  9: 1:          0.00 :   -0.90:      2.70:    -1.80:      1.80:
 10: 1:          0.00 :   -1.10:      2.90:    -2.00:      2.00:
 S  : M:  NUMBER       :        S2          :        S           :
 T  : A:    OF         :                    :                    :
 E  : T:  FATIGUE      :                    :                    :
 P  : L:  CYCLES       :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:---------------:---------:---------:---------:---------:
  1: 1:         19.14 :   -0.30:      0.30:     0.00:      0.00:
  2: 1:          2.29 :   -0.50:      0.50:     0.00:      0.00:
  3: 1:          1.14 :   -0.60:      0.60:     0.00:      0.00:
  4: 1:          0.23 :   -0.80:      0.80:     0.00:      0.00:
  5: 1:          0.04 :   -1.00:      1.00:     0.00:      0.00:
  6: 1:          0.01 :   -1.20:      1.20:     0.00:      0.00:
  7: 1:          0.00 :   -1.40:      1.40:     0.00:      0.00:
  8: 1:          0.00 :   -1.60:      1.60:     0.00:      0.00:
  9: 1:          0.00 :   -1.80:      1.80:     0.00:      0.00:
 10: 1:          0.00 :   -2.00:      2.00:     0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
 S  : M:  NUMBER       :        S0          :        S1          :
 T  : A:    OF         :                    :                    :
 E  : T:  FATIGUE      :                    :                    :
 P  : L:  CYCLES       :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:---------------:---------:---------:---------:---------:
  1: 1:         38.29 :    0.60:      1.20:    -0.30:      0.30:
  2: 1:          4.57 :    0.40:      1.40:    -0.50:      0.50:
  3: 1:          2.29 :    0.30:      1.50:    -0.60:      0.60:
  4: 1:          0.46 :    0.10:      1.70:    -0.80:      0.80:
  5: 1:          0.08 :   -0.10:      1.90:    -1.00:      1.00:
  6: 1:          0.02 :   -0.30:      2.10:    -1.20:      1.20:
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
   7: 1:          0.01 :   -0.50:     2.30:    -1.40:      1.40:
   8: 1:          0.00 :   -0.70:     2.50:    -1.60:      1.60:
   9: 1:          0.00 :   -0.90:     2.70:    -1.80:      1.80:
  10: 1:          0.00 :   -1.10:     2.90:    -2.00:      2.00:
 S   : M:  NUMBER      :      S2          :        S           :
 T   : A:    OF        :                  :                    :
 E   : T:  FATIGUE     :                  :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)   :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         38.29 :   -0.30:     0.30:     0.00:      0.00:
   2: 1:          4.57 :   -0.50:     0.50:     0.00:      0.00:
   3: 1:          2.29 :   -0.60:     0.60:     0.00:      0.00:
   4: 1:          0.46 :   -0.80:     0.80:     0.00:      0.00:
   5: 1:          0.08 :   -1.00:     1.00:     0.00:      0.00:
   6: 1:          0.02 :   -1.20:     1.20:     0.00:      0.00:
   7: 1:          0.01 :   -1.40:     1.40:     0.00:      0.00:
   8: 1:          0.00 :   -1.60:     1.60:     0.00:      0.00:
   9: 1:          0.00 :   -1.80:     1.80:     0.00:      0.00:
  10: 1:          0.00 :   -2.00:     2.00:     0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  5
 S   : M:  NUMBER      :      S0          :        S1          :
 T   : A:    OF        :                  :                    :
 E   : T:  FATIGUE     :                  :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)   :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          0.28 :    1.00:     1.01:     1.00:      1.01:
   2: 1:          0.44 :    0.81:     1.06:     0.81:      1.06:
   3: 1:          0.22 :    0.62:     1.12:     0.62:      1.12:
   4: 1:          0.06 :    0.43:     1.18:     0.42:      1.18:
   5: 1:          0.00 :    0.23:     1.24:     0.23:      1.24:
   6: 1:          0.00 :    0.04:     1.30:     0.04:      1.30:
 S   : M:  NUMBER      :      S2          :        S           :
 T   : A:    OF        :                  :                    :
 E   : T:  FATIGUE     :                  :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)   :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          0.28 :    1.00:     1.00:     0.00:      0.00:
   2: 1:          0.44 :    0.81:     1.06:     0.00:      0.00:
   3: 1:          0.22 :    0.62:     1.12:     0.00:      0.00:
   4: 1:          0.06 :    0.43:     1.18:     0.00:      0.00:
   5: 1:          0.00 :    0.23:     1.24:     0.00:      0.00:
   6: 1:          0.00 :    0.04:     1.30:     0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

 TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
 S   : M:  NUMBER      :      S0          :        S1          :
 T   : A:    OF        :                  :                    :
 E   : T:  FATIGUE     :     (ksi)        :       (ksi)        :
 P   : L:  CYCLES      :   (t1) :  (t2)   :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          1.90 :   -0.70:    -1.30:     0.00:      0.00:
   2: 1:          0.09 :   -0.60:    -1.40:     0.00:      0.00:
   3: 1:          0.01 :   -0.54:    -1.46:     0.00:      0.00:
 S   : M:  NUMBER      :      S2          :        S           :
 T   : A:    OF        :                  :                    :
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

E P	T: L:	FATIGUE CYCLES	(ksi) (t1)	 (t2)	(ksi) (t1)	 (t2)
1:	1:	1.90	0.00	0.00	0.00	0.00
2:	1:	0.09	0.00	0.00	0.00	0.00
3:	1:	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	9.57	3.22	6.44	0.00	0.00
2:	1:	1.14	2.15	7.52	0.00	0.00
3:	1:	0.57	1.61	8.05	0.00	0.00
4:	1:	0.11	0.54	9.13	0.00	0.00
5:	1:	0.02	-0.54	10.20	0.00	0.00
6:	1:	0.01	-1.61	11.28	0.00	0.00
7:	1:	0.00	-2.68	12.35	0.00	0.00
8:	1:	0.00	-3.76	13.43	0.00	0.00
9:	1:	0.00	-4.83	14.50	0.00	0.00
10:	1:	0.00	-5.91	15.57	0.00	0.00

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	9.57	0.00	0.00	0.00	0.00
2:	1:	1.14	0.00	0.00	0.00	0.00
3:	1:	0.57	0.00	0.00	0.00	0.00
4:	1:	0.11	0.00	0.00	0.00	0.00
5:	1:	0.02	0.00	0.00	0.00	0.00
6:	1:	0.01	0.00	0.00	0.00	0.00
7:	1:	0.00	0.00	0.00	0.00	0.00
8:	1:	0.00	0.00	0.00	0.00	0.00
9:	1:	0.00	0.00	0.00	0.00	0.00
10:	1:	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	19.14	3.22	6.44	0.00	0.00
2:	1:	2.29	2.15	7.52	0.00	0.00
3:	1:	1.14	1.61	8.05	0.00	0.00
4:	1:	0.23	0.54	9.13	0.00	0.00
5:	1:	0.04	-0.54	10.20	0.00	0.00
6:	1:	0.01	-1.61	11.28	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
7	1	0.00	-2.68	12.35	0.00	0.00
8	1	0.00	-3.76	13.43	0.00	0.00
9	1	0.00	-4.83	14.50	0.00	0.00
10	1	0.00	-5.91	15.57	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00
2	1	2.29	0.00	0.00	0.00	0.00
3	1	1.14	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.04	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	3.22	6.44	0.00	0.00
2	1	4.57	2.15	7.52	0.00	0.00
3	1	2.29	1.61	8.05	0.00	0.00
4	1	0.46	0.54	9.13	0.00	0.00
5	1	0.08	-0.54	10.20	0.00	0.00
6	1	0.02	-1.61	11.28	0.00	0.00
7	1	0.01	-2.68	12.35	0.00	0.00
8	1	0.00	-3.76	13.43	0.00	0.00
9	1	0.00	-4.83	14.50	0.00	0.00
10	1	0.00	-5.91	15.57	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	38.29	0.00	0.00	0.00	0.00
2	1	4.57	0.00	0.00	0.00	0.00
3	1	2.29	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.08	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
----------------------------------
STD
 S  : M:  NUMBER      :       S0           :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :      (ksi)         :       (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)     :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.28 :    4.05:     4.09:     0.00:     0.00:
   2: 1:         0.44 :    3.28:     4.29:     0.00:     0.00:
   3: 1:         0.22 :    2.51:     4.54:     0.00:     0.00:
   4: 1:         0.06 :    1.74:     4.78:     0.00:     0.00:
   5: 1:         0.00 :    0.93:     5.02:     0.00:     0.00:
   6: 1:         0.00 :    0.16:     5.26:     0.00:     0.00:
 S  : M:  NUMBER      :       S2           :        S           :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :      (ksi)         :       (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)     :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.28 :    0.00:     0.00:     0.00:     0.00:
   2: 1:         0.44 :    0.00:     0.00:     0.00:     0.00:
   3: 1:         0.22 :    0.00:     0.00:     0.00:     0.00:
   4: 1:         0.06 :    0.00:     0.00:     0.00:     0.00:
   5: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:
   6: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

ANALYSIS RESULTS:
-----------------



 Schedl    Block          Final Flaw Size            K max
                  Step          c                    c-tip
    100      15              0.414804             7.506543
    200      15              0.437688             7.787127
    300      15              0.464649             8.120896
    400      15              0.497261             8.530501
    500      15              0.538222             9.056281
    600      15              0.592774             9.780616
    700      15              0.673513            10.915370
    800      15              0.828719            13.371923

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     51.84     K ref =     0.000     K cr =     51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.      14  of Schedule No.     848
Crack Size      c =    1.03995

                 FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
                DATE: 17-MAR-99   TIME: 09:33:40
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W1 SA226 MS, .005 crack in cap WS 99

GEOMETRY
--------
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =     0.1250
Plate Width, W     =     3.0000
Hole Diameter, D   =     0.1600
Hole-Center-to-Edge Dist., B =     0.3100
Poisson s ratio    =     0.30

FLAW SIZE:

a   (init.) =  0.5000E-02
c   (init.) =  0.5000E-02
a/c (init.) =   1.000



MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    6.6000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    6.6000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S1:    0.0000
```

Scale Factor for Stress S3: 6.6000

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 3.5000
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 4.9700

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	1.90	0.70	1.30	0.00	0.00
2	1	0.09	0.60	1.40	0.00	0.00
3	1	0.01	0.54	1.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	9.57	0.60	1.20	-0.30	0.30
2	1	1.14	0.40	1.40	-0.50	0.50
3	1	0.57	0.30	1.50	-0.60	0.60
4	1	0.11	0.10	1.70	-0.80	0.80
5	1	0.02	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	9.57 :	0.60:	1.20:	0.00:	0.00:
2:	1:	1.14 :	0.40:	1.40:	0.00:	0.00:
3:	1:	0.57 :	0.30:	1.50:	0.00:	0.00:
4:	1:	0.11 :	0.10:	1.70:	0.00:	0.00:
5:	1:	0.02 :	-0.10:	1.90:	0.00:	0.00:
6:	1:	0.01 :	-0.30:	2.10:	0.00:	0.00:
7:	1:	0.00 :	-0.50:	2.30:	0.00:	0.00:
8:	1:	0.00 :	-0.70:	2.50:	0.00:	0.00:
9:	1:	0.00 :	-0.90:	2.70:	0.00:	0.00:
10:	1:	0.00 :	-1.10:	2.90:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	19.14 :	0.60:	1.20:	-0.30:	0.30:
2:	1:	2.29 :	0.40:	1.40:	-0.50:	0.50:
3:	1:	1.14 :	0.30:	1.50:	-0.60:	0.60:
4:	1:	0.23 :	0.10:	1.70:	-0.80:	0.80:
5:	1:	0.04 :	-0.10:	1.90:	-1.00:	1.00:
6:	1:	0.01 :	-0.30:	2.10:	-1.20:	1.20:
7:	1:	0.00 :	-0.50:	2.30:	-1.40:	1.40:
8:	1:	0.00 :	-0.70:	2.50:	-1.60:	1.60:
9:	1:	0.00 :	-0.90:	2.70:	-1.80:	1.80:
10:	1:	0.00 :	-1.10:	2.90:	-2.00:	2.00:

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	19.14 :	0.60:	1.20:	0.00:	0.00:
2:	1:	2.29 :	0.40:	1.40:	0.00:	0.00:
3:	1:	1.14 :	0.30:	1.50:	0.00:	0.00:
4:	1:	0.23 :	0.10:	1.70:	0.00:	0.00:
5:	1:	0.04 :	-0.10:	1.90:	0.00:	0.00:
6:	1:	0.01 :	-0.30:	2.10:	0.00:	0.00:
7:	1:	0.00 :	-0.50:	2.30:	0.00:	0.00:
8:	1:	0.00 :	-0.70:	2.50:	0.00:	0.00:
9:	1:	0.00 :	-0.90:	2.70:	0.00:	0.00:
10:	1:	0.00 :	-1.10:	2.90:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	38.29 :	0.60:	1.20:	-0.30:	0.30:
2:	1:	4.57 :	0.40:	1.40:	-0.50:	0.50:
3:	1:	2.29 :	0.30:	1.50:	-0.60:	0.60:
4:	1:	0.46 :	0.10:	1.70:	-0.80:	0.80:
5:	1:	0.08 :	-0.10:	1.90:	-1.00:	1.00:

```
  6: 1:         0.02 :   -0.30:     2.10:    -1.20:     1.20:
  7: 1:         0.01 :   -0.50:     2.30:    -1.40:     1.40:
  8: 1:         0.00 :   -0.70:     2.50:    -1.60:     1.60:
  9: 1:         0.00 :   -0.90:     2.70:    -1.80:     1.80:
 10: 1:         0.00 :   -1.10:     2.90:    -2.00:     2.00:
S   : M:  NUMBER     :        S3          :        S          :
T   : A:    OF       :                    :                   :
E   : T:  FATIGUE    :                    :                   :
P   : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        38.29 :    0.60:     1.20:     0.00:     0.00:
  2: 1:         4.57 :    0.40:     1.40:     0.00:     0.00:
  3: 1:         2.29 :    0.30:     1.50:     0.00:     0.00:
  4: 1:         0.46 :    0.10:     1.70:     0.00:     0.00:
  5: 1:         0.08 :   -0.10:     1.90:     0.00:     0.00:
  6: 1:         0.02 :   -0.30:     2.10:     0.00:     0.00:
  7: 1:         0.01 :   -0.50:     2.30:     0.00:     0.00:
  8: 1:         0.00 :   -0.70:     2.50:     0.00:     0.00:
  9: 1:         0.00 :   -0.90:     2.70:     0.00:     0.00:
 10: 1:         0.00 :   -1.10:     2.90:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  5
S   : M:  NUMBER     :        S0          :        S1         :
T   : A:    OF       :                    :                   :
E   : T:  FATIGUE    :                    :                   :
P   : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         0.28 :    1.00:     1.01:     1.00:     1.01:
  2: 1:         0.44 :    0.81:     1.06:     0.81:     1.06:
  3: 1:         0.22 :    0.62:     1.12:     0.62:     1.12:
  4: 1:         0.06 :    0.43:     1.18:     0.42:     1.18:
  5: 1:         0.00 :    0.23:     1.24:     0.23:     1.24:
  6: 1:         0.00 :    0.04:     1.30:     0.04:     1.30:
S   : M:  NUMBER     :        S3          :        S          :
T   : A:    OF       :                    :                   :
E   : T:  FATIGUE    :                    :                   :
P   : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         0.28 :    1.00:     1.00:     0.00:     0.00:
  2: 1:         0.44 :    0.81:     1.06:     0.00:     0.00:
  3: 1:         0.22 :    0.62:     1.12:     0.00:     0.00:
  4: 1:         0.06 :    0.43:     1.18:     0.00:     0.00:
  5: 1:         0.00 :    0.23:     1.24:     0.00:     0.00:
  6: 1:         0.00 :    0.04:     1.30:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER     :        S0          :        S1         :
T   : A:    OF       :                    :                   :
E   : T:  FATIGUE    :      (ksi)         :      (ksi)        :
P   : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         1.90 :   -0.70:    -1.30:     0.00:     0.00:
  2: 1:         0.09 :   -0.60:    -1.40:     0.00:     0.00:
  3: 1:         0.01 :   -0.54:    -1.46:     0.00:     0.00:
S   : M:  NUMBER     :        S3          :        S          :
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

T : A:	OF				
E : T:	FATIGUE	(ksi)		(ksi)	
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	1.90	-0.70	-1.30	0.00	0.00
2: 1:	0.09	-0.60	-1.40	0.00	0.00
3: 1:	0.01	-0.54	-1.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S : M:	NUMBER	S0		S1	
T : A:	OF				
E : T:	FATIGUE	(ksi)		(ksi)	
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	9.57	2.78	5.57	0.00	0.00
2: 1:	1.14	1.86	6.50	0.00	0.00
3: 1:	0.57	1.39	6.96	0.00	0.00
4: 1:	0.11	0.46	7.89	0.00	0.00
5: 1:	0.02	-0.46	8.82	0.00	0.00
6: 1:	0.01	-1.39	9.74	0.00	0.00
7: 1:	0.00	-2.32	10.67	0.00	0.00
8: 1:	0.00	-3.25	11.60	0.00	0.00
9: 1:	0.00	-4.18	12.53	0.00	0.00
10: 1:	0.00	-5.10	13.46	0.00	0.00

S : M:	NUMBER	S3		S	
T : A:	OF				
E : T:	FATIGUE	(ksi)		(ksi)	
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	9.57	3.96	7.92	0.00	0.00
2: 1:	1.14	2.64	9.24	0.00	0.00
3: 1:	0.57	1.98	9.90	0.00	0.00
4: 1:	0.11	0.66	11.22	0.00	0.00
5: 1:	0.02	-0.66	12.54	0.00	0.00
6: 1:	0.01	-1.98	13.86	0.00	0.00
7: 1:	0.00	-3.30	15.18	0.00	0.00
8: 1:	0.00	-4.62	16.50	0.00	0.00
9: 1:	0.00	-5.94	17.82	0.00	0.00
10: 1:	0.00	-7.26	19.14	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S : M:	NUMBER	S0		S1	
T : A:	OF				
E : T:	FATIGUE	(ksi)		(ksi)	
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	19.14	2.78	5.57	0.00	0.00
2: 1:	2.29	1.86	6.50	0.00	0.00
3: 1:	1.14	1.39	6.96	0.00	0.00
4: 1:	0.23	0.46	7.89	0.00	0.00
5: 1:	0.04	-0.46	8.82	0.00	0.00

6	1	0.01	-1.39	9.74	0.00	0.00
7	1	0.00	-2.32	10.67	0.00	0.00
8	1	0.00	-3.25	11.60	0.00	0.00
9	1	0.00	-4.18	12.53	0.00	0.00
10	1	0.00	-5.10	13.46	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	(t2)	S (ksi) (t1)	(t2)
1	1	19.14	3.96	7.92	0.00	0.00
2	1	2.29	2.64	9.24	0.00	0.00
3	1	1.14	1.98	9.90	0.00	0.00
4	1	0.23	0.66	11.22	0.00	0.00
5	1	0.04	-0.66	12.54	0.00	0.00
6	1	0.01	-1.98	13.86	0.00	0.00
7	1	0.00	-3.30	15.18	0.00	0.00
8	1	0.00	-4.62	16.50	0.00	0.00
9	1	0.00	-5.94	17.82	0.00	0.00
10	1	0.00	-7.26	19.14	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	(t2)	S1 (ksi) (t1)	(t2)
1	1	38.29	2.78	5.57	0.00	0.00
2	1	4.57	1.86	6.50	0.00	0.00
3	1	2.29	1.39	6.96	0.00	0.00
4	1	0.46	0.46	7.89	0.00	0.00
5	1	0.08	-0.46	8.82	0.00	0.00
6	1	0.02	-1.39	9.74	0.00	0.00
7	1	0.01	-2.32	10.67	0.00	0.00
8	1	0.00	-3.25	11.60	0.00	0.00
9	1	0.00	-4.18	12.53	0.00	0.00
10	1	0.00	-5.10	13.46	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	(t2)	S (ksi) (t1)	(t2)
1	1	38.29	3.96	7.92	0.00	0.00
2	1	4.57	2.64	9.24	0.00	0.00
3	1	2.29	1.98	9.90	0.00	0.00
4	1	0.46	0.66	11.22	0.00	0.00
5	1	0.08	-0.66	12.54	0.00	0.00
6	1	0.02	-1.98	13.86	0.00	0.00
7	1	0.01	-3.30	15.18	0.00	0.00
8	1	0.00	-4.62	16.50	0.00	0.00
9	1	0.00	-5.94	17.82	0.00	0.00
10	1	0.00	-7.26	19.14	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.28	3.50	3.54	0.00	0.00
2	1	0.44	2.83	3.71	0.00	0.00
3	1	0.22	2.17	3.92	0.00	0.00
4	1	0.06	1.50	4.13	0.00	0.00
5	1	0.00	0.81	4.34	0.00	0.00
6	1	0.00	0.14	4.55	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	4.97	4.97	0.00	0.00
2	1	0.44	4.03	5.27	0.00	0.00
3	1	0.22	3.08	5.57	0.00	0.00
4	1	0.06	2.14	5.86	0.00	0.00
5	1	0.00	1.14	6.16	0.00	0.00
6	1	0.00	0.20	6.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block	Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15		0.005018	0.005011	1.655102	1.572091
400	15		0.005037	0.005022	1.657014	1.574721
600	15		0.005055	0.005034	1.658953	1.577353
800	15		0.005074	0.005046	1.660917	1.579989
1000	15		0.005093	0.005058	1.662906	1.582630
1200	15		0.005112	0.005070	1.664919	1.585275
1400	15		0.005131	0.005082	1.666957	1.587926
1600	15		0.005150	0.005095	1.669019	1.590582
1800	15		0.005169	0.005107	1.671104	1.593243
2000	15		0.005189	0.005120	1.673213	1.595911
2200	15		0.005208	0.005133	1.675345	1.598585
2400	15		0.005228	0.005147	1.677500	1.601266
2600	15		0.005248	0.005160	1.679677	1.603953
2800	15		0.005268	0.005174	1.681878	1.606648
3000	15		0.005288	0.005188	1.684102	1.609351
3200	15		0.005309	0.005202	1.686348	1.612061
3400	15		0.005329	0.005216	1.688616	1.614779
3600	15		0.005350	0.005230	1.690908	1.617505
3800	15		0.005371	0.005245	1.693221	1.620240
4000	15		0.005392	0.005260	1.695557	1.622984
4200	15		0.005413	0.005274	1.697915	1.625736
4400	15		0.005434	0.005290	1.700296	1.628497
4600	15		0.005456	0.005305	1.702699	1.631268
4800	15		0.005477	0.005320	1.705125	1.634048
5000	15		0.005499	0.005336	1.707573	1.636838
5200	15		0.005521	0.005352	1.710043	1.639638
5400	15		0.005543	0.005368	1.712536	1.642448

5600	15	0.005566	0.005384	1.715051	1.645269
5800	15	0.005588	0.005401	1.717589	1.648099
6000	15	0.005611	0.005418	1.720149	1.650941
6200	15	0.005634	0.005434	1.722732	1.653793
6400	15	0.005657	0.005451	1.725337	1.656657
6600	15	0.005680	0.005469	1.727965	1.659532
6800	15	0.005704	0.005486	1.730616	1.662418
7000	15	0.005727	0.005504	1.733290	1.665316
7200	15	0.005751	0.005522	1.735986	1.668225
7400	15	0.005775	0.005540	1.738706	1.671147
7600	15	0.005800	0.005558	1.741456	1.674147
7800	15	0.005826	0.005576	1.744242	1.677263
8000	15	0.005852	0.005595	1.747059	1.680452
8200	15	0.005879	0.005614	1.749908	1.683701
8400	15	0.005906	0.005633	1.752787	1.687004
8600	15	0.005934	0.005653	1.755698	1.690356
8800	15	0.005962	0.005672	1.758639	1.693755
9000	15	0.005990	0.005692	1.761611	1.697197
9200	15	0.006020	0.005712	1.764614	1.700682
9400	15	0.006049	0.005733	1.767649	1.704208
9600	15	0.006079	0.005753	1.770716	1.707774
9800	15	0.006110	0.005774	1.773814	1.711379
10000	15	0.006140	0.005796	1.776945	1.715022

MODEL: CC02

ANALYSIS RESULTS (contd.)

Schdl	Block Step	Final Flaw Size a	c	K max a-tip	c-tip
10200	15	0.006172	0.005817	1.780108	1.718703
10400	15	0.006203	0.005839	1.783303	1.722421
10600	15	0.006236	0.005861	1.786532	1.726176
10800	15	0.006268	0.005883	1.789794	1.729967
11000	15	0.006301	0.005906	1.793090	1.733794
11200	15	0.006335	0.005929	1.796420	1.737658
11400	15	0.006369	0.005952	1.799783	1.741556
11600	15	0.006404	0.005976	1.803182	1.745491
11800	15	0.006439	0.005999	1.806615	1.749460
12000	15	0.006474	0.006024	1.810084	1.753465
12200	15	0.006510	0.006048	1.813588	1.757505
12400	15	0.006546	0.006073	1.817127	1.761580
12600	15	0.006583	0.006098	1.820703	1.765691
12800	15	0.006621	0.006124	1.824316	1.769836
13000	15	0.006659	0.006150	1.827965	1.774017
13200	15	0.006697	0.006176	1.831656	1.778232
13400	15	0.006736	0.006203	1.835509	1.782438
13600	15	0.006775	0.006232	1.839485	1.786651
13800	15	0.006815	0.006262	1.843558	1.790884
14000	15	0.006856	0.006292	1.847718	1.795140
14200	15	0.006897	0.006323	1.851959	1.799423
14400	15	0.006939	0.006355	1.856277	1.803736
14600	15	0.006982	0.006387	1.860670	1.808079
14800	15	0.007025	0.006420	1.865135	1.812456
15000	15	0.007069	0.006454	1.869672	1.816867
15200	15	0.007113	0.006488	1.874279	1.821313
15400	15	0.007158	0.006523	1.878955	1.825795
15600	15	0.007204	0.006559	1.883701	1.830315
15800	15	0.007250	0.006595	1.888514	1.834873
16000	15	0.007298	0.006632	1.893396	1.839471
16200	15	0.007346	0.006670	1.898346	1.844109
16400	15	0.007394	0.006708	1.903364	1.848787
16600	15	0.007444	0.006748	1.908451	1.853508
16800	15	0.007494	0.006787	1.913605	1.858271
17000	15	0.007545	0.006828	1.918827	1.863078

17200	15	0.007597	0.006869	1.924118	1.867928
17400	15	0.007650	0.006911	1.929478	1.872823
17600	15	0.007703	0.006954	1.934907	1.877764
17800	15	0.007758	0.006997	1.940405	1.882751
18000	15	0.007813	0.007041	1.945973	1.887784
18200	15	0.007869	0.007086	1.951611	1.892865
18400	15	0.007927	0.007131	1.957319	1.897995
18600	15	0.007985	0.007178	1.963099	1.903173
18800	15	0.008044	0.007225	1.968950	1.908401
19000	15	0.008104	0.007273	1.974874	1.913679

```
FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No.         0.00  of Load Step No.   6
Step description:
of Block No.     15  of Schedule No.   19000
Crack Sizes:  a =  0.810418E-02  , c =  0.727303E-02 ,  a/c =   1.1142


                 FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
               DATE: 17-MAR-99    TIME: 08:04:23
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W1 SA226 MS, cont damage in cap WS99

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    3.0000
Hole Diameter, D   =    0.1600
Hole-Center-to-Edge Dist., B =    0.3100
Poisson s ratio    =    0.30

FLAW SIZE:

a   (init.) =  0.5990E-02
c   (init.) =  0.5694E-02
a/c (init.) =   1.052



MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:----------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    -1.0000
Scale Factor for Stress S1:     0.0000
Scale Factor for Stress S3:    -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:     5.4100
Scale Factor for Stress S1:     0.0000
Scale Factor for Stress S3:     16.910

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:     5.4100
Scale Factor for Stress S1:     0.0000
Scale Factor for Stress S3:     16.910

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:     5.4100
Scale Factor for Stress S1:     0.0000
Scale Factor for Stress S3:     16.910

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:     4.0700
Scale Factor for Stress S1:     0.0000
Scale Factor for Stress S3:     12.730

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                     Block Case No.
From   -   To
    1   -     1                             1
    2   -     2                             2
    3   -     3                             5
    4   -     4                             1
    5   -     5                             3
    6   -     6                             5
    7   -     7                             1
    8   -     8                             3
    9   -     9                             5
   10   -    10                             1
   11   -    11                             3
   12   -    12                             5
   13   -    13                             1
   14   -    14                             4
   15   -    15                             5

BLOCK CASE NO.  1
 S  : M:  NUMBER     :        S0          :        S1          :
 T  : A:    OF       :                    :                    :
 E  : T:  FATIGUE    :                    :                    :
 P  : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.90 :     0.70:     1.30:     0.70:     1.30:
```

```
  2: 1:         0.09 :    0.60:     1.40:     0.60:     1.40:
  3: 1:         0.01 :    0.54:     1.46:     0.54:     1.46:
S   : M:  NUMBER     :       S3           :       S            :
T   : A:    OF       :                    :                    :
E   : T:  FATIGUE    :                    :                    :
P   : L:  CYCLES     :   (t1)  :  (t2)    :   (t1)  :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         1.90 :    0.70:     1.30:     0.00:     0.00:
  2: 1:         0.09 :    0.60:     1.40:     0.00:     0.00:
  3: 1:         0.01 :    0.54:     1.46:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
S   : M:  NUMBER     :       S0           :       S1           :
T   : A:    OF       :                    :                    :
E   : T:  FATIGUE    :                    :                    :
P   : L:  CYCLES     :   (t1)  :  (t2)    :   (t1)  :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         9.57 :    0.60:     1.20:    -0.30:     0.30:
  2: 1:         1.14 :    0.40:     1.40:    -0.50:     0.50:
  3: 1:         0.57 :    0.30:     1.50:    -0.60:     0.60:
  4: 1:         0.11 :    0.10:     1.70:    -0.80:     0.80:
  5: 1:         0.02 :   -0.10:     1.90:    -1.00:     1.00:
  6: 1:         0.01 :   -0.30:     2.10:    -1.20:     1.20:
  7: 1:         0.00 :   -0.50:     2.30:    -1.40:     1.40:
  8: 1:         0.00 :   -0.70:     2.50:    -1.60:     1.60:
  9: 1:         0.00 :   -0.90:     2.70:    -1.80:     1.80:
 10: 1:         0.00 :   -1.10:     2.90:    -2.00:     2.00:
S   : M:  NUMBER     :       S3           :       S            :
T   : A:    OF       :                    :                    :
E   : T:  FATIGUE    :                    :                    :
P   : L:  CYCLES     :   (t1)  :  (t2)    :   (t1)  :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         9.57 :    0.60:     1.20:     0.00:     0.00:
  2: 1:         1.14 :    0.40:     1.40:     0.00:     0.00:
  3: 1:         0.57 :    0.30:     1.50:     0.00:     0.00:
  4: 1:         0.11 :    0.10:     1.70:     0.00:     0.00:
  5: 1:         0.02 :   -0.10:     1.90:     0.00:     0.00:
  6: 1:         0.01 :   -0.30:     2.10:     0.00:     0.00:
  7: 1:         0.00 :   -0.50:     2.30:     0.00:     0.00:
  8: 1:         0.00 :   -0.70:     2.50:     0.00:     0.00:
  9: 1:         0.00 :   -0.90:     2.70:     0.00:     0.00:
 10: 1:         0.00 :   -1.10:     2.90:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
S   : M:  NUMBER     :       S0           :       S1           :
T   : A:    OF       :                    :                    :
E   : T:  FATIGUE    :                    :                    :
P   : L:  CYCLES     :   (t1)  :  (t2)    :   (t1)  :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        19.14 :    0.60:     1.20:    -0.30:     0.30:
  2: 1:         2.29 :    0.40:     1.40:    -0.50:     0.50:
  3: 1:         1.14 :    0.30:     1.50:    -0.60:     0.60:
  4: 1:         0.23 :    0.10:     1.70:    -0.80:     0.80:
  5: 1:         0.04 :   -0.10:     1.90:    -1.00:     1.00:
  6: 1:         0.01 :   -0.30:     2.10:    -1.20:     1.20:
  7: 1:         0.00 :   -0.50:     2.30:    -1.40:     1.40:
  8: 1:         0.00 :   -0.70:     2.50:    -1.60:     1.60:
  9: 1:         0.00 :   -0.90:     2.70:    -1.80:     1.80:
 10: 1:         0.00 :   -1.10:     2.90:    -2.00:     2.00:
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	19.14	0.60	1.20	0.00	0.00
2	1	2.29	0.40	1.40	0.00	0.00
3	1	1.14	0.30	1.50	0.00	0.00
4	1	0.23	0.10	1.70	0.00	0.00
5	1	0.04	-0.10	1.90	0.00	0.00
6	1	0.01	-0.30	2.10	0.00	0.00
7	1	0.00	-0.50	2.30	0.00	0.00
8	1	0.00	-0.70	2.50	0.00	0.00
9	1	0.00	-0.90	2.70	0.00	0.00
10	1	0.00	-1.10	2.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.60	1.20	-0.30	0.30
2	1	4.57	0.40	1.40	-0.50	0.50
3	1	2.29	0.30	1.50	-0.60	0.60
4	1	0.46	0.10	1.70	-0.80	0.80
5	1	0.08	-0.10	1.90	-1.00	1.00
6	1	0.02	-0.30	2.10	-1.20	1.20
7	1	0.01	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	38.29	0.60	1.20	0.00	0.00
2	1	4.57	0.40	1.40	0.00	0.00
3	1	2.29	0.30	1.50	0.00	0.00
4	1	0.46	0.10	1.70	0.00	0.00
5	1	0.08	-0.10	1.90	0.00	0.00
6	1	0.02	-0.30	2.10	0.00	0.00
7	1	0.01	-0.50	2.30	0.00	0.00
8	1	0.00	-0.70	2.50	0.00	0.00
9	1	0.00	-0.90	2.70	0.00	0.00
10	1	0.00	-1.10	2.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24

```
  6: 1:          0.00 :     0.04:      1.30:      0.04:      1.30:
S   : M:  NUMBER      :       S3           :        S            :
T   : A:    OF        :                    :                     :
E   : T:  FATIGUE     :                    :                     :
P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)     :
----:--:--------------:---------:----------:---------:-----------:
  1: 1:          0.28 :     1.00:      1.00:      0.00:      0.00:
  2: 1:          0.44 :     0.81:      1.06:      0.00:      0.00:
  3: 1:          0.22 :     0.62:      1.12:      0.00:      0.00:
  4: 1:          0.06 :     0.43:      1.18:      0.00:      0.00:
  5: 1:          0.00 :     0.23:      1.24:      0.00:      0.00:
  6: 1:          0.00 :     0.04:      1.30:      0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER      :       S0           :        S1           :
T   : A:    OF        :                    :                     :
E   : T:  FATIGUE     :      (ksi)         :       (ksi)         :
P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)     :
----:--:--------------:---------:----------:---------:-----------:
  1: 1:          1.90 :    -0.70:     -1.30:      0.00:      0.00:
  2: 1:          0.09 :    -0.60:     -1.40:      0.00:      0.00:
  3: 1:          0.01 :    -0.54:     -1.46:      0.00:      0.00:
S   : M:  NUMBER      :       S3           :        S            :
T   : A:    OF        :                    :                     :
E   : T:  FATIGUE     :      (ksi)         :       (ksi)         :
P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)     :
----:--:--------------:---------:----------:---------:-----------:
  1: 1:          1.90 :    -0.70:     -1.30:      0.00:      0.00:
  2: 1:          0.09 :    -0.60:     -1.40:      0.00:      0.00:
  3: 1:          0.01 :    -0.54:     -1.46:      0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER      :       S0           :        S1           :
T   : A:    OF        :                    :                     :
E   : T:  FATIGUE     :      (ksi)         :       (ksi)         :
P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)     :
----:--:--------------:---------:----------:---------:-----------:
  1: 1:          9.57 :     3.25:      6.49:      0.00:      0.00:
  2: 1:          1.14 :     2.16:      7.57:      0.00:      0.00:
  3: 1:          0.57 :     1.62:      8.12:      0.00:      0.00:
  4: 1:          0.11 :     0.54:      9.20:      0.00:      0.00:
  5: 1:          0.02 :    -0.54:     10.28:      0.00:      0.00:
  6: 1:          0.01 :    -1.62:     11.36:      0.00:      0.00:
  7: 1:          0.00 :    -2.70:     12.44:      0.00:      0.00:
  8: 1:          0.00 :    -3.79:     13.53:      0.00:      0.00:
  9: 1:          0.00 :    -4.87:     14.61:      0.00:      0.00:
 10: 1:          0.00 :    -5.95:     15.69:      0.00:      0.00:
S   : M:  NUMBER      :       S3           :        S            :
T   : A:    OF        :                    :                     :
E   : T:  FATIGUE     :      (ksi)         :       (ksi)         :
P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)     :
```

1:	1:	9.57 :	10.15:	20.29:	0.00:	0.00:
2:	1:	1.14 :	6.76:	23.67:	0.00:	0.00:
3:	1:	0.57 :	5.07:	25.37:	0.00:	0.00:
4:	1:	0.11 :	1.69:	28.75:	0.00:	0.00:
5:	1:	0.02 :	-1.69:	32.13:	0.00:	0.00:
6:	1:	0.01 :	-5.07:	35.51:	0.00:	0.00:
7:	1:	0.00 :	-8.45:	38.89:	0.00:	0.00:
8:	1:	0.00 :	-11.84:	42.27:	0.00:	0.00:
9:	1:	0.00 :	-15.22:	45.66:	0.00:	0.00:
10:	1:	0.00 :	-18.60:	49.04:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	19.14 :	3.25:	6.49:	0.00:	0.00:
2:	1:	2.29 :	2.16:	7.57:	0.00:	0.00:
3:	1:	1.14 :	1.62:	8.12:	0.00:	0.00:
4:	1:	0.23 :	0.54:	9.20:	0.00:	0.00:
5:	1:	0.04 :	-0.54:	10.28:	0.00:	0.00:
6:	1:	0.01 :	-1.62:	11.36:	0.00:	0.00:
7:	1:	0.00 :	-2.70:	12.44:	0.00:	0.00:
8:	1:	0.00 :	-3.79:	13.53:	0.00:	0.00:
9:	1:	0.00 :	-4.87:	14.61:	0.00:	0.00:
10:	1:	0.00 :	-5.95:	15.69:	0.00:	0.00:

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	19.14 :	10.15:	20.29:	0.00:	0.00:
2:	1:	2.29 :	6.76:	23.67:	0.00:	0.00:
3:	1:	1.14 :	5.07:	25.37:	0.00:	0.00:
4:	1:	0.23 :	1.69:	28.75:	0.00:	0.00:
5:	1:	0.04 :	-1.69:	32.13:	0.00:	0.00:
6:	1:	0.01 :	-5.07:	35.51:	0.00:	0.00:
7:	1:	0.00 :	-8.45:	38.89:	0.00:	0.00:
8:	1:	0.00 :	-11.84:	42.27:	0.00:	0.00:
9:	1:	0.00 :	-15.22:	45.66:	0.00:	0.00:
10:	1:	0.00 :	-18.60:	49.04:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	38.29 :	3.25:	6.49:	0.00:	0.00:

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

2:	1:	4.57 :	2.16:	7.57:	0.00:	0.00:
3:	1:	2.29 :	1.62:	8.12:	0.00:	0.00:
4:	1:	0.46 :	0.54:	9.20:	0.00:	0.00:
5:	1:	0.08 :	-0.54:	10.28:	0.00:	0.00:
6:	1:	0.02 :	-1.62:	11.36:	0.00:	0.00:
7:	1:	0.01 :	-2.70:	12.44:	0.00:	0.00:
8:	1:	0.00 :	-3.79:	13.53:	0.00:	0.00:
9:	1:	0.00 :	-4.87:	14.61:	0.00:	0.00:
10:	1:	0.00 :	-5.95:	15.69:	0.00:	0.00:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	38.29 :	10.15:	20.29:	0.00:	0.00:
2:	1:	4.57 :	6.76:	23.67:	0.00:	0.00:
3:	1:	2.29 :	5.07:	25.37:	0.00:	0.00:
4:	1:	0.46 :	1.69:	28.75:	0.00:	0.00:
5:	1:	0.08 :	-1.69:	32.13:	0.00:	0.00:
6:	1:	0.02 :	-5.07:	35.51:	0.00:	0.00:
7:	1:	0.01 :	-8.45:	38.89:	0.00:	0.00:
8:	1:	0.00 :	-11.84:	42.27:	0.00:	0.00:
9:	1:	0.00 :	-15.22:	45.66:	0.00:	0.00:
10:	1:	0.00 :	-18.60:	49.04:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28 :	4.07:	4.11:	0.00:	0.00:
2:	1:	0.44 :	3.30:	4.31:	0.00:	0.00:
3:	1:	0.22 :	2.52:	4.56:	0.00:	0.00:
4:	1:	0.06 :	1.75:	4.80:	0.00:	0.00:
5:	1:	0.00 :	0.94:	5.05:	0.00:	0.00:
6:	1:	0.00 :	0.16:	5.29:	0.00:	0.00:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	0.28 :	12.73:	12.73:	0.00:	0.00:
2:	1:	0.44 :	10.31:	13.49:	0.00:	0.00:
3:	1:	0.22 :	7.89:	14.26:	0.00:	0.00:
4:	1:	0.06 :	5.47:	15.02:	0.00:	0.00:
5:	1:	0.00 :	2.93:	15.79:	0.00:	0.00:
6:	1:	0.00 :	0.51:	16.55:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

ANALYSIS RESULTS:

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

Schdl	Block	Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15		0.006659	0.006230	3.015652	2.875163
400	15		0.007464	0.006872	3.153642	3.000460
600	15		0.008446	0.007648	3.308426	3.136948
800	15		0.009660	0.008591	3.481832	3.285647
1000	15		0.011181	0.009745	3.675493	3.447213
1200	15		0.013109	0.011168	3.890434	3.621662
1400	15		0.015579	0.012929	4.126533	3.808002
1600	15		0.018765	0.015112	4.381808	4.003931
1800	15		0.022881	0.017813	4.651749	4.205785
2000	15		0.028175	0.021132	4.929098	4.409024
2200	15		0.034909	0.025169	5.204511	4.609406
2400	15		0.043320	0.030021	5.468229	4.804590
2600	15		0.053588	0.035783	5.712173	4.995573
2800	15		0.065815	0.042574	5.931448	5.187258
3000	15		0.080017	0.050562	6.124439	5.388088
3200	15		0.096141	0.060016	6.291426	5.609068
3400	15		0.114065	0.071366	6.431765	5.862221

```
Transition to 1-d solution, TC03:
a =   0.1250       t =   0.1250
at Cycle No.          2.29  of Load Step No.   3
Step description:
of Block No.      14  of Schedule No.    3514
Crack Size:  c =  0.789220E-01 ,  a/c =   1.58386
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
3600	15		0.086811	6.146306
3800	15		0.106762	6.364160
4000	15		0.131321	6.818620
4200	15		0.172247	8.415349

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     54.81     K ref =     0.000     K cr =     51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.      14  of Schedule No.    4257
Crack Size      c =  0.219182
```

```
                  FATIGUE CRACK GROWTH ANALYSIS
                  -------Modified by FAI-------
                DATE: 17-MAR-99    TIME: 09:27:59
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC5, PSE-W1 crack in angle on web side of hole WS99

GEOMETRY
--------
MODEL: TC05-Through crack from hole in row of holes.

Plate Thickness, t =    0.1250
Hole Dia., D       =    0.1590
Hole-to-Hole Dist., H      =    0.6800
Dia./Edge-Dist. Ratio, D/B =    0.0000
(D/B = 0 means B is very large)

FLAW SIZE:
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
c   (init.) =  0.8200E-01



MATERIAL
--------

MATL 1:
         1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC05

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S3:   -1.0000
Scale Factor for Stress S4:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    3.8400
Scale Factor for Stress S3:    9.6200
Scale Factor for Stress S4:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    3.8400
Scale Factor for Stress S3:    9.6200
Scale Factor for Stress S4:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    3.8400
Scale Factor for Stress S3:    9.6200
Scale Factor for Stress S4:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    2.9000
Scale Factor for Stress S3:    7.2500
Scale Factor for Stress S4:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	1.90	-0.30	0.30	0.00	0.00
2	1	0.09	-0.40	0.40	0.00	0.00
3	1	0.01	-0.46	0.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	9.57	0.60	1.20	0.60	1.20
2	1	1.14	0.40	1.40	0.40	1.40
3	1	0.57	0.30	1.50	0.30	1.50
4	1	0.11	0.10	1.70	0.10	1.70
5	1	0.02	-0.10	1.90	-0.10	1.90
6	1	0.01	-0.30	2.10	-0.30	2.10
7	1	0.00	-0.50	2.30	-0.50	2.30
8	1	0.00	-0.70	2.50	-0.70	2.50
9	1	0.00	-0.90	2.70	-0.90	2.70
10	1	0.00	-1.10	2.90	-1.10	2.90

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	9.57	-0.30	0.30	0.00	0.00
2	1	1.14	-0.50	0.50	0.00	0.00
3	1	0.57	-0.60	0.60	0.00	0.00
4	1	0.11	-0.80	0.80	0.00	0.00
5	1	0.02	-1.00	1.00	0.00	0.00
6	1	0.01	-1.20	1.20	0.00	0.00

7:	1:	0.00 :	-1.40:	1.40:	0.00:	0.00:
8:	1:	0.00 :	-1.60:	1.60:	0.00:	0.00:
9:	1:	0.00 :	-1.80:	1.80:	0.00:	0.00:
10:	1:	0.00 :	-2.00:	2.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	19.14 :	0.60:	1.20:	0.60:	1.20:
2:	1:	2.29 :	0.40:	1.40:	0.40:	1.40:
3:	1:	1.14 :	0.30:	1.50:	0.30:	1.50:
4:	1:	0.23 :	0.10:	1.70:	0.10:	1.70:
5:	1:	0.04 :	-0.10:	1.90:	-0.10:	1.90:
6:	1:	0.01 :	-0.30:	2.10:	-0.30:	2.10:
7:	1:	0.00 :	-0.50:	2.30:	-0.50:	2.30:
8:	1:	0.00 :	-0.70:	2.50:	-0.70:	2.50:
9:	1:	0.00 :	-0.90:	2.70:	-0.90:	2.70:
10:	1:	0.00 :	-1.10:	2.90:	-1.10:	2.90:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1:	1:	19.14 :	-0.30:	0.30:	0.00:	0.00:
2:	1:	2.29 :	-0.50:	0.50:	0.00:	0.00:
3:	1:	1.14 :	-0.60:	0.60:	0.00:	0.00:
4:	1:	0.23 :	-0.80:	0.80:	0.00:	0.00:
5:	1:	0.04 :	-1.00:	1.00:	0.00:	0.00:
6:	1:	0.01 :	-1.20:	1.20:	0.00:	0.00:
7:	1:	0.00 :	-1.40:	1.40:	0.00:	0.00:
8:	1:	0.00 :	-1.60:	1.60:	0.00:	0.00:
9:	1:	0.00 :	-1.80:	1.80:	0.00:	0.00:
10:	1:	0.00 :	-2.00:	2.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	38.29 :	0.60:	1.20:	0.60:	1.20:
2:	1:	4.57 :	0.40:	1.40:	0.40:	1.40:
3:	1:	2.29 :	0.30:	1.50:	0.30:	1.50:
4:	1:	0.46 :	0.10:	1.70:	0.10:	1.70:
5:	1:	0.08 :	-0.10:	1.90:	-0.10:	1.90:
6:	1:	0.02 :	-0.30:	2.10:	-0.30:	2.10:
7:	1:	0.01 :	-0.50:	2.30:	-0.50:	2.30:
8:	1:	0.00 :	-0.70:	2.50:	-0.70:	2.50:
9:	1:	0.00 :	-0.90:	2.70:	-0.90:	2.70:
10:	1:	0.00 :	-1.10:	2.90:	-1.10:	2.90:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1:	1:	38.29 :	-0.30:	0.30:	0.00:	0.00:

2	1	4.57	-0.50	0.50	0.00	0.00
3	1	2.29	-0.60	0.60	0.00	0.00
4	1	0.46	-0.80	0.80	0.00	0.00
5	1	0.08	-1.00	1.00	0.00	0.00
6	1	0.02	-1.20	1.20	0.00	0.00
7	1	0.01	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W1 crack in angle
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	-0.70	-1.30	-0.70	-1.30
2	1	0.09	-0.60	-1.40	-0.60	-1.40
3	1	0.01	-0.54	-1.46	-0.54	-1.46

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

TC5, PSE-W1 crack in angle
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	2.30	4.61	5.77	11.54
2	1	1.14	1.54	5.38	3.85	13.47
3	1	0.57	1.15	5.76	2.89	14.43
4	1	0.11	0.38	6.53	0.96	16.35
5	1	0.02	-0.38	7.30	-0.96	18.28
6	1	0.01	-1.15	8.06	-2.89	20.20
7	1	0.00	-1.92	8.83	-4.81	22.13
8	1	0.00	-2.69	9.60	-6.73	24.05
9	1	0.00	-3.46	10.37	-8.66	25.97
10	1	0.00	-4.22	11.14	-10.58	27.90

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	0.00	0.00	0.00	0.00
2	1	1.14	0.00	0.00	0.00	0.00
3	1	0.57	0.00	0.00	0.00	0.00
4	1	0.11	0.00	0.00	0.00	0.00
5	1	0.02	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W1 crack in angle
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	2.30	4.61	5.77	11.54
2	1	2.29	1.54	5.38	3.85	13.47
3	1	1.14	1.15	5.76	2.89	14.43
4	1	0.23	0.38	6.53	0.96	16.35
5	1	0.04	-0.38	7.30	-0.96	18.28
6	1	0.01	-1.15	8.06	-2.89	20.20
7	1	0.00	-1.92	8.83	-4.81	22.13
8	1	0.00	-2.69	9.60	-6.73	24.05
9	1	0.00	-3.46	10.37	-8.66	25.97
10	1	0.00	-4.22	11.14	-10.58	27.90

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

2:	1:	2.29	0.00	0.00	0.00	0.00
3:	1:	1.14	0.00	0.00	0.00	0.00
4:	1:	0.23	0.00	0.00	0.00	0.00
5:	1:	0.04	0.00	0.00	0.00	0.00
6:	1:	0.01	0.00	0.00	0.00	0.00
7:	1:	0.00	0.00	0.00	0.00	0.00
8:	1:	0.00	0.00	0.00	0.00	0.00
9:	1:	0.00	0.00	0.00	0.00	0.00
10:	1:	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W1 crack in angle
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	38.29	2.30	4.61	5.77	11.54
2:	1:	4.57	1.54	5.38	3.85	13.47
3:	1:	2.29	1.15	5.76	2.89	14.43
4:	1:	0.46	0.38	6.53	0.96	16.35
5:	1:	0.08	-0.38	7.30	-0.96	18.28
6:	1:	0.02	-1.15	8.06	-2.89	20.20
7:	1:	0.01	-1.92	8.83	-4.81	22.13
8:	1:	0.00	-2.69	9.60	-6.73	24.05
9:	1:	0.00	-3.46	10.37	-8.66	25.97
10:	1:	0.00	-4.22	11.14	-10.58	27.90

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	38.29	0.00	0.00	0.00	0.00
2:	1:	4.57	0.00	0.00	0.00	0.00
3:	1:	2.29	0.00	0.00	0.00	0.00
4:	1:	0.46	0.00	0.00	0.00	0.00
5:	1:	0.08	0.00	0.00	0.00	0.00
6:	1:	0.02	0.00	0.00	0.00	0.00
7:	1:	0.01	0.00	0.00	0.00	0.00
8:	1:	0.00	0.00	0.00	0.00	0.00
9:	1:	0.00	0.00	0.00	0.00	0.00
10:	1:	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W1 crack in angle
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.28	2.90	2.93	7.25	7.32
2:	1:	0.44	2.35	3.07	5.87	7.69
3:	1:	0.22	1.80	3.25	4.50	8.12

```
   4: 1:         0.06 :      1.25:     3.42:     3.04:     8.55:
   5: 1:         0.00 :      0.67:     3.60:     1.67:     8.99:
   6: 1:         0.00 :      0.12:     3.77:     0.29:     9.43:
 S   : M:  NUMBER     :        S4          :        S          :
 T   : A:    OF       :                    :                   :
 E   : T:  FATIGUE    :       (ksi)        :       (ksi)       :
 P   : L:  CYCLES     :     (t1) :  (t2)   :     (t1) :  (t2)  :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.28 :      0.00:     0.00:     0.00:     0.00:
   2: 1:         0.44 :      0.00:     0.00:     0.00:     0.00:
   3: 1:         0.22 :      0.00:     0.00:     0.00:     0.00:
   4: 1:         0.06 :      0.00:     0.00:     0.00:     0.00:
   5: 1:         0.00 :      0.00:     0.00:     0.00:     0.00:
   6: 1:         0.00 :      0.00:     0.00:     0.00:     0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W1 crack in angle
MODEL: TC05

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.085795	4.229266
400	15		0.089634	4.240978
600	15		0.093517	4.252673
800	15		0.097445	4.264351
1000	15		0.101418	4.275931
1200	15		0.105435	4.287248
1400	15		0.109496	4.298236
1600	15		0.113601	4.309098
1800	15		0.117749	4.320051
2000	15		0.121942	4.331298
2200	15		0.126181	4.343026
2400	15		0.130471	4.355411
2600	15		0.134814	4.368612
2800	15		0.139214	4.382779
3000	15		0.143678	4.398049
3200	15		0.148210	4.414548
3400	15		0.152818	4.432388
3600	15		0.157508	4.451671
3800	15		0.162289	4.472484
4000	15		0.167169	4.494898
4200	15		0.172157	4.518965
4400	15		0.177263	4.544712
4600	15		0.182498	4.572133
4800	15		0.187872	4.601183
5000	15		0.193395	4.631766
5200	15		0.199080	4.663716
5400	15		0.204935	4.696782
5600	15		0.210969	4.730614
5800	15		0.217191	4.765028
6000	15		0.223608	4.800159
6200	15		0.230228	4.836187
6400	15		0.237064	4.873327
6600	15		0.244128	4.911827
6800	15		0.251434	4.951980
7000	15		0.259000	4.994135
7200	15		0.266849	5.038703
7400	15		0.275005	5.086177
7600	15		0.283500	5.137156
7800	15		0.292371	5.192368

8000	15	0.301668	5.252719
8200	15	0.311447	5.319348
8400	15	0.321786	5.393739
8600	15	0.332780	5.477983
8800	15	0.344562	5.574999
9000	15	0.357311	5.688929
9200	15	0.371286	5.825919
9400	15	0.386875	5.995607
9600	15	0.404700	6.214272
9800	15	0.425858	6.514394
10000	15	0.453301	7.100117

```
FINAL RESULTS:
All Stress Intensities are below the Fatigue Threshold.
NO growth in Schedule No.   10195
Crack Size      c =  0.521007


                  FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
                DATE: 17-MAR-99    TIME: 09:42:42
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W1 SA226 MS, cont damage in cap WS99

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    3.0000
Hole Diameter, D   =    0.1600
Hole-Center-to-Edge Dist., B =    0.3100
Poisson s ratio    =    0.30

FLAW SIZE:

a   (init.) =  0.6815E-02
c   (init.) =  0.6264E-02
a/c (init.) =   1.088



MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl: UTS :  YS  : K1e : K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 : 74.0: 65.0: 27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    5.4100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    16.910

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    5.4100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    16.910

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    5.4100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    16.910

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    4.0700
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    12.730

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                Block Case No.
From   -   To
    1  -    1                       1
    2  -    2                       2
    3  -    3                       5
    4  -    4                       1
    5  -    5                       3
    6  -    6                       5
    7  -    7                       1
    8  -    8                       3
    9  -    9                       5
   10  -   10                       1
   11  -   11                       3
   12  -   12                       5
   13  -   13                       1
   14  -   14                       4
   15  -   15                       5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :        S0          :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :  (t1) :  (t2)      :  (t1) :  (t2)      :
----:--:--------------:---------:----------:---------:----------:
   1: 1:        1.90  :   0.70:      1.30:    0.70:      1.30:
   2: 1:        0.09  :   0.60:      1.40:    0.60:      1.40:
   3: 1:        0.01  :   0.54:      1.46:    0.54:      1.46:
```

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	1.90	0.70	1.30	0.00	0.00
2	1	0.09	0.60	1.40	0.00	0.00
3	1	0.01	0.54	1.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	9.57	0.60	1.20	-0.30	0.30
2	1	1.14	0.40	1.40	-0.50	0.50
3	1	0.57	0.30	1.50	-0.60	0.60
4	1	0.11	0.10	1.70	-0.80	0.80
5	1	0.02	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	9.57	0.60	1.20	0.00	0.00
2	1	1.14	0.40	1.40	0.00	0.00
3	1	0.57	0.30	1.50	0.00	0.00
4	1	0.11	0.10	1.70	0.00	0.00
5	1	0.02	-0.10	1.90	0.00	0.00
6	1	0.01	-0.30	2.10	0.00	0.00
7	1	0.00	-0.50	2.30	0.00	0.00
8	1	0.00	-0.70	2.50	0.00	0.00
9	1	0.00	-0.90	2.70	0.00	0.00
10	1	0.00	-1.10	2.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.60	1.20	-0.30	0.30
2	1	2.29	0.40	1.40	-0.50	0.50
3	1	1.14	0.30	1.50	-0.60	0.60
4	1	0.23	0.10	1.70	-0.80	0.80
5	1	0.04	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

S : M: NUMBER	S3	S
T : A: OF		

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
E   : T:  FATIGUE     :                     :                     :
P   : L:  CYCLES      :   (t1) :  (t2)     :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
  1: 1:       19.14 :    0.60:     1.20:     0.00:     0.00:
  2: 1:        2.29 :    0.40:     1.40:     0.00:     0.00:
  3: 1:        1.14 :    0.30:     1.50:     0.00:     0.00:
  4: 1:        0.23 :    0.10:     1.70:     0.00:     0.00:
  5: 1:        0.04 :   -0.10:     1.90:     0.00:     0.00:
  6: 1:        0.01 :   -0.30:     2.10:     0.00:     0.00:
  7: 1:        0.00 :   -0.50:     2.30:     0.00:     0.00:
  8: 1:        0.00 :   -0.70:     2.50:     0.00:     0.00:
  9: 1:        0.00 :   -0.90:     2.70:     0.00:     0.00:
 10: 1:        0.00 :   -1.10:     2.90:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
S   : M:  NUMBER      :        S0           :        S1           :
T   : A:    OF        :                     :                     :
E   : T:  FATIGUE     :                     :                     :
P   : L:  CYCLES      :   (t1) :  (t2)     :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
  1: 1:       38.29 :    0.60:     1.20:    -0.30:     0.30:
  2: 1:        4.57 :    0.40:     1.40:    -0.50:     0.50:
  3: 1:        2.29 :    0.30:     1.50:    -0.60:     0.60:
  4: 1:        0.46 :    0.10:     1.70:    -0.80:     0.80:
  5: 1:        0.08 :   -0.10:     1.90:    -1.00:     1.00:
  6: 1:        0.02 :   -0.30:     2.10:    -1.20:     1.20:
  7: 1:        0.01 :   -0.50:     2.30:    -1.40:     1.40:
  8: 1:        0.00 :   -0.70:     2.50:    -1.60:     1.60:
  9: 1:        0.00 :   -0.90:     2.70:    -1.80:     1.80:
 10: 1:        0.00 :   -1.10:     2.90:    -2.00:     2.00:
S   : M:  NUMBER      :        S3           :        S            :
T   : A:    OF        :                     :                     :
E   : T:  FATIGUE     :                     :                     :
P   : L:  CYCLES      :   (t1) :  (t2)     :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
  1: 1:       38.29 :    0.60:     1.20:     0.00:     0.00:
  2: 1:        4.57 :    0.40:     1.40:     0.00:     0.00:
  3: 1:        2.29 :    0.30:     1.50:     0.00:     0.00:
  4: 1:        0.46 :    0.10:     1.70:     0.00:     0.00:
  5: 1:        0.08 :   -0.10:     1.90:     0.00:     0.00:
  6: 1:        0.02 :   -0.30:     2.10:     0.00:     0.00:
  7: 1:        0.01 :   -0.50:     2.30:     0.00:     0.00:
  8: 1:        0.00 :   -0.70:     2.50:     0.00:     0.00:
  9: 1:        0.00 :   -0.90:     2.70:     0.00:     0.00:
 10: 1:        0.00 :   -1.10:     2.90:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  5
S   : M:  NUMBER      :        S0           :        S1           :
T   : A:    OF        :                     :                     :
E   : T:  FATIGUE     :                     :                     :
P   : L:  CYCLES      :   (t1) :  (t2)     :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        0.28 :    1.00:     1.01:     1.00:     1.01:
  2: 1:        0.44 :    0.81:     1.06:     0.81:     1.06:
  3: 1:        0.22 :    0.62:     1.12:     0.62:     1.12:
  4: 1:        0.06 :    0.43:     1.18:     0.42:     1.18:
  5: 1:        0.00 :    0.23:     1.24:     0.23:     1.24:
  6: 1:        0.00 :    0.04:     1.30:     0.04:     1.30:
S   : M:  NUMBER      :        S3           :        S            :
```

T E P	A T L	OF FATIGUE CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	3.25	6.49	0.00	0.00
2	1	1.14	2.16	7.57	0.00	0.00
3	1	0.57	1.62	8.12	0.00	0.00
4	1	0.11	0.54	9.20	0.00	0.00
5	1	0.02	-0.54	10.28	0.00	0.00
6	1	0.01	-1.62	11.36	0.00	0.00
7	1	0.00	-2.70	12.44	0.00	0.00
8	1	0.00	-3.79	13.53	0.00	0.00
9	1	0.00	-4.87	14.61	0.00	0.00
10	1	0.00	-5.95	15.69	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	10.15	20.29	0.00	0.00

2:	1:	1.14 :	6.76:	23.67:	0.00:	0.00:
3:	1:	0.57 :	5.07:	25.37:	0.00:	0.00:
4:	1:	0.11 :	1.69:	28.75:	0.00:	0.00:
5:	1:	0.02 :	-1.69:	32.13:	0.00:	0.00:
6:	1:	0.01 :	-5.07:	35.51:	0.00:	0.00:
7:	1:	0.00 :	-8.45:	38.89:	0.00:	0.00:
8:	1:	0.00 :	-11.84:	42.27:	0.00:	0.00:
9:	1:	0.00 :	-15.22:	45.66:	0.00:	0.00:
10:	1:	0.00 :	-18.60:	49.04:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	19.14 :	3.25:	6.49:	0.00:	0.00:
2:	1:	2.29 :	2.16:	7.57:	0.00:	0.00:
3:	1:	1.14 :	1.62:	8.12:	0.00:	0.00:
4:	1:	0.23 :	0.54:	9.20:	0.00:	0.00:
5:	1:	0.04 :	-0.54:	10.28:	0.00:	0.00:
6:	1:	0.01 :	-1.62:	11.36:	0.00:	0.00:
7:	1:	0.00 :	-2.70:	12.44:	0.00:	0.00:
8:	1:	0.00 :	-3.79:	13.53:	0.00:	0.00:
9:	1:	0.00 :	-4.87:	14.61:	0.00:	0.00:
10:	1:	0.00 :	-5.95:	15.69:	0.00:	0.00:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	19.14 :	10.15:	20.29:	0.00:	0.00:
2:	1:	2.29 :	6.76:	23.67:	0.00:	0.00:
3:	1:	1.14 :	5.07:	25.37:	0.00:	0.00:
4:	1:	0.23 :	1.69:	28.75:	0.00:	0.00:
5:	1:	0.04 :	-1.69:	32.13:	0.00:	0.00:
6:	1:	0.01 :	-5.07:	35.51:	0.00:	0.00:
7:	1:	0.00 :	-8.45:	38.89:	0.00:	0.00:
8:	1:	0.00 :	-11.84:	42.27:	0.00:	0.00:
9:	1:	0.00 :	-15.22:	45.66:	0.00:	0.00:
10:	1:	0.00 :	-18.60:	49.04:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	38.29 :	3.25:	6.49:	0.00:	0.00:
2:	1:	4.57 :	2.16:	7.57:	0.00:	0.00:
3:	1:	2.29 :	1.62:	8.12:	0.00:	0.00:

```
   4: 1:          0.46 :    0.54:     9.20:     0.00:     0.00:
   5: 1:          0.08 :   -0.54:    10.28:     0.00:     0.00:
   6: 1:          0.02 :   -1.62:    11.36:     0.00:     0.00:
   7: 1:          0.01 :   -2.70:    12.44:     0.00:     0.00:
   8: 1:          0.00 :   -3.79:    13.53:     0.00:     0.00:
   9: 1:          0.00 :   -4.87:    14.61:     0.00:     0.00:
  10: 1:          0.00 :   -5.95:    15.69:     0.00:     0.00:
 S  : M:  NUMBER      :        S3          :        S          :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :      (ksi)         :      (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         38.29 :   10.15:    20.29:     0.00:     0.00:
   2: 1:          4.57 :    6.76:    23.67:     0.00:     0.00:
   3: 1:          2.29 :    5.07:    25.37:     0.00:     0.00:
   4: 1:          0.46 :    1.69:    28.75:     0.00:     0.00:
   5: 1:          0.08 :   -1.69:    32.13:     0.00:     0.00:
   6: 1:          0.02 :   -5.07:    35.51:     0.00:     0.00:
   7: 1:          0.01 :   -8.45:    38.89:     0.00:     0.00:
   8: 1:          0.00 :  -11.84:    42.27:     0.00:     0.00:
   9: 1:          0.00 :  -15.22:    45.66:     0.00:     0.00:
  10: 1:          0.00 :  -18.60:    49.04:     0.00:     0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

```
STD
 S  : M:  NUMBER      :        S0          :        S1         :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :      (ksi)         :      (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          0.28 :    4.07:     4.11:     0.00:     0.00:
   2: 1:          0.44 :    3.30:     4.31:     0.00:     0.00:
   3: 1:          0.22 :    2.52:     4.56:     0.00:     0.00:
   4: 1:          0.06 :    1.75:     4.80:     0.00:     0.00:
   5: 1:          0.00 :    0.94:     5.05:     0.00:     0.00:
   6: 1:          0.00 :    0.16:     5.29:     0.00:     0.00:
 S  : M:  NUMBER      :        S3          :        S          :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :      (ksi)         :      (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          0.28 :   12.73:    12.73:     0.00:     0.00:
   2: 1:          0.44 :   10.31:    13.49:     0.00:     0.00:
   3: 1:          0.22 :    7.89:    14.26:     0.00:     0.00:
   4: 1:          0.06 :    5.47:    15.02:     0.00:     0.00:
   5: 1:          0.00 :    2.93:    15.79:     0.00:     0.00:
   6: 1:          0.00 :    0.51:    16.55:     0.00:     0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

ANALYSIS RESULTS:

Schdl   Block   Final Flaw Size   K max

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

		Step	a	c	a-tip	c-tip
200	15		0.007634	0.006938	3.168770	3.030949
400	15		0.008640	0.007748	3.328484	3.166185
600	15		0.009889	0.008729	3.506543	3.314499
800	15		0.011459	0.009927	3.704611	3.476344
1000	15		0.013457	0.011402	3.923669	3.651488
1200	15		0.016021	0.013225	4.163445	3.838648
1400	15		0.019331	0.015484	4.421681	4.035210
1600	15		0.023608	0.018274	4.693507	4.237245
1800	15		0.029105	0.021697	4.971328	4.440098
2000	15		0.036079	0.025853	5.245642	4.639659
2200	15		0.044763	0.030837	5.506836	4.833983
2400	15		0.055326	0.036749	5.747266	5.024629
2600	15		0.067855	0.043709	5.962577	5.217070
2800	15		0.082355	0.051900	6.151572	5.420207
3000	15		0.098763	0.061612	6.314614	5.645317
3200	15		0.116945	0.073302	6.450552	5.904355

```
Transition to 1-d solution, TC03:
a =   0.1250       t =   0.1250
at Cycle No.          0.23  of Load Step No.   4
Step description:
of Block No.       8  of Schedule No.    3284
Crack Size:  c =  0.789221E-01 ,  a/c =    1.58386
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
3400	15		0.089683	6.170652
3600	15		0.110103	6.412594
3800	15		0.135851	6.931619
4000	15		0.185310	9.417865

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     52.78      K ref =     0.000      K cr =    51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.       8  of Schedule No.    4027
Crack Size       c =  0.218315

                 FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
                DATE: 17-MAR-99   TIME: 09:49:45
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC5, PSE-W1, continuing crack in cap on web side of hole WS99

GEOMETRY
--------
MODEL: TC05-Through crack from hole in row of holes.

Plate Thickness, t =    0.1250
Hole Dia., D       =    0.1590
Hole-to-Hole Dist., H      =    0.6800
Dia./Edge-Dist. Ratio, D/B =    0.0000
(D/B = 0 means B is very large)

FLAW SIZE:

c   (init.) =  0.7300E-01
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC05

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S3:   -1.0000
Scale Factor for Stress S4:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    5.4100
Scale Factor for Stress S3:    16.910
Scale Factor for Stress S4:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    5.4100
Scale Factor for Stress S3:    16.910
Scale Factor for Stress S4:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    5.4100
Scale Factor for Stress S3:    16.910
Scale Factor for Stress S4:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    4.0700
Scale Factor for Stress S3:    12.730
Scale Factor for Stress S4:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                     Block Case No.
From    -    To
    1   -     1                        1
```

2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	1.90	0.70:	1.30:	0.70:	1.30:
2:	1:	0.09	0.60:	1.40:	0.60:	1.40:
3:	1:	0.01	0.54:	1.46:	0.54:	1.46:

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1:	1:	1.90	-0.30:	0.30:	0.00:	0.00:
2:	1:	0.09	-0.40:	0.40:	0.00:	0.00:
3:	1:	0.01	-0.46:	0.46:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	9.57	0.60:	1.20:	0.60:	1.20:
2:	1:	1.14	0.40:	1.40:	0.40:	1.40:
3:	1:	0.57	0.30:	1.50:	0.30:	1.50:
4:	1:	0.11	0.10:	1.70:	0.10:	1.70:
5:	1:	0.02	-0.10:	1.90:	-0.10:	1.90:
6:	1:	0.01	-0.30:	2.10:	-0.30:	2.10:
7:	1:	0.00	-0.50:	2.30:	-0.50:	2.30:
8:	1:	0.00	-0.70:	2.50:	-0.70:	2.50:
9:	1:	0.00	-0.90:	2.70:	-0.90:	2.70:
10:	1:	0.00	-1.10:	2.90:	-1.10:	2.90:

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1:	1:	9.57	-0.30:	0.30:	0.00:	0.00:
2:	1:	1.14	-0.50:	0.50:	0.00:	0.00:
3:	1:	0.57	-0.60:	0.60:	0.00:	0.00:
4:	1:	0.11	-0.80:	0.80:	0.00:	0.00:
5:	1:	0.02	-1.00:	1.00:	0.00:	0.00:
6:	1:	0.01	-1.20:	1.20:	0.00:	0.00:
7:	1:	0.00	-1.40:	1.40:	0.00:	0.00:
8:	1:	0.00	-1.60:	1.60:	0.00:	0.00:
9:	1:	0.00	-1.80:	1.80:	0.00:	0.00:

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	0.60	1.20	0.60	1.20
2	1	2.29	0.40	1.40	0.40	1.40
3	1	1.14	0.30	1.50	0.30	1.50
4	1	0.23	0.10	1.70	0.10	1.70
5	1	0.04	-0.10	1.90	-0.10	1.90
6	1	0.01	-0.30	2.10	-0.30	2.10
7	1	0.00	-0.50	2.30	-0.50	2.30
8	1	0.00	-0.70	2.50	-0.70	2.50
9	1	0.00	-0.90	2.70	-0.90	2.70
10	1	0.00	-1.10	2.90	-1.10	2.90

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	19.14	-0.30	0.30	0.00	0.00
2	1	2.29	-0.50	0.50	0.00	0.00
3	1	1.14	-0.60	0.60	0.00	0.00
4	1	0.23	-0.80	0.80	0.00	0.00
5	1	0.04	-1.00	1.00	0.00	0.00
6	1	0.01	-1.20	1.20	0.00	0.00
7	1	0.00	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	0.60	1.20	0.60	1.20
2	1	4.57	0.40	1.40	0.40	1.40
3	1	2.29	0.30	1.50	0.30	1.50
4	1	0.46	0.10	1.70	0.10	1.70
5	1	0.08	-0.10	1.90	-0.10	1.90
6	1	0.02	-0.30	2.10	-0.30	2.10
7	1	0.01	-0.50	2.30	-0.50	2.30
8	1	0.00	-0.70	2.50	-0.70	2.50
9	1	0.00	-0.90	2.70	-0.90	2.70
10	1	0.00	-1.10	2.90	-1.10	2.90

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	38.29	-0.30	0.30	0.00	0.00
2	1	4.57	-0.50	0.50	0.00	0.00
3	1	2.29	-0.60	0.60	0.00	0.00
4	1	0.46	-0.80	0.80	0.00	0.00

5:	1:	0.08 :	-1.00:	1.00:	0.00:	0.00:
6:	1:	0.02 :	-1.20:	1.20:	0.00:	0.00:
7:	1:	0.01 :	-1.40:	1.40:	0.00:	0.00:
8:	1:	0.00 :	-1.60:	1.60:	0.00:	0.00:
9:	1:	0.00 :	-1.80:	1.80:	0.00:	0.00:
10:	1:	0.00 :	-2.00:	2.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	0.28 :	1.00:	1.01:	1.00:	1.01:
2:	1:	0.44 :	0.81:	1.06:	0.81:	1.06:
3:	1:	0.22 :	0.62:	1.12:	0.62:	1.12:
4:	1:	0.06 :	0.43:	1.18:	0.42:	1.18:
5:	1:	0.00 :	0.23:	1.24:	0.23:	1.24:
6:	1:	0.00 :	0.04:	1.30:	0.04:	1.30:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1:	1:	0.28 :	1.00:	1.00:	0.00:	0.00:
2:	1:	0.44 :	0.81:	1.06:	0.00:	0.00:
3:	1:	0.22 :	0.62:	1.12:	0.00:	0.00:
4:	1:	0.06 :	0.43:	1.18:	0.00:	0.00:
5:	1:	0.00 :	0.23:	1.24:	0.00:	0.00:
6:	1:	0.00 :	0.04:	1.30:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W1, continuing cra
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	1.90 :	-0.70:	-1.30:	-0.70:	-1.30:
2:	1:	0.09 :	-0.60:	-1.40:	-0.60:	-1.40:
3:	1:	0.01 :	-0.54:	-1.46:	-0.54:	-1.46:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	1.90 :	0.00:	0.00:	0.00:	0.00:
2:	1:	0.09 :	0.00:	0.00:	0.00:	0.00:
3:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W1, continuing cra
MODEL: TC05

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	3.25	6.49	10.15	20.29
2	1	1.14	2.16	7.57	6.76	23.67
3	1	0.57	1.62	8.12	5.07	25.37
4	1	0.11	0.54	9.20	1.69	28.75
5	1	0.02	-0.54	10.28	-1.69	32.13
6	1	0.01	-1.62	11.36	-5.07	35.51
7	1	0.00	-2.70	12.44	-8.45	38.89
8	1	0.00	-3.79	13.53	-11.84	42.27
9	1	0.00	-4.87	14.61	-15.22	45.66
10	1	0.00	-5.95	15.69	-18.60	49.04

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	0.00	0.00	0.00	0.00
2	1	1.14	0.00	0.00	0.00	0.00
3	1	0.57	0.00	0.00	0.00	0.00
4	1	0.11	0.00	0.00	0.00	0.00
5	1	0.02	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W1, continuing cra
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	3.25	6.49	10.15	20.29
2	1	2.29	2.16	7.57	6.76	23.67
3	1	1.14	1.62	8.12	5.07	25.37
4	1	0.23	0.54	9.20	1.69	28.75
5	1	0.04	-0.54	10.28	-1.69	32.13
6	1	0.01	-1.62	11.36	-5.07	35.51
7	1	0.00	-2.70	12.44	-8.45	38.89
8	1	0.00	-3.79	13.53	-11.84	42.27
9	1	0.00	-4.87	14.61	-15.22	45.66
10	1	0.00	-5.95	15.69	-18.60	49.04

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00
2	1	2.29	0.00	0.00	0.00	0.00
3	1	1.14	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00

```
   5: 1:          0.04 :     0.00:      0.00:      0.00:      0.00:
   6: 1:          0.01 :     0.00:      0.00:      0.00:      0.00:
   7: 1:          0.00 :     0.00:      0.00:      0.00:      0.00:
   8: 1:          0.00 :     0.00:      0.00:      0.00:      0.00:
   9: 1:          0.00 :     0.00:      0.00:      0.00:      0.00:
  10: 1:          0.00 :     0.00:      0.00:      0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC5, PSE-W1, continuing cra
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
 S   : M:  NUMBER      :        S0          :        S3          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :      (ksi)         :      (ksi)         :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         38.29 :     3.25:      6.49:     10.15:     20.29:
   2: 1:          4.57 :     2.16:      7.57:      6.76:     23.67:
   3: 1:          2.29 :     1.62:      8.12:      5.07:     25.37:
   4: 1:          0.46 :     0.54:      9.20:      1.69:     28.75:
   5: 1:          0.08 :    -0.54:     10.28:     -1.69:     32.13:
   6: 1:          0.02 :    -1.62:     11.36:     -5.07:     35.51:
   7: 1:          0.01 :    -2.70:     12.44:     -8.45:     38.89:
   8: 1:          0.00 :    -3.79:     13.53:    -11.84:     42.27:
   9: 1:          0.00 :    -4.87:     14.61:    -15.22:     45.66:
  10: 1:          0.00 :    -5.95:     15.69:    -18.60:     49.04:
 S   : M:  NUMBER      :        S4          :        S           :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :      (ksi)         :      (ksi)         :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         38.29 :     0.00:      0.00:      0.00:      0.00:
   2: 1:          4.57 :     0.00:      0.00:      0.00:      0.00:
   3: 1:          2.29 :     0.00:      0.00:      0.00:      0.00:
   4: 1:          0.46 :     0.00:      0.00:      0.00:      0.00:
   5: 1:          0.08 :     0.00:      0.00:      0.00:      0.00:
   6: 1:          0.02 :     0.00:      0.00:      0.00:      0.00:
   7: 1:          0.01 :     0.00:      0.00:      0.00:      0.00:
   8: 1:          0.00 :     0.00:      0.00:      0.00:      0.00:
   9: 1:          0.00 :     0.00:      0.00:      0.00:      0.00:
  10: 1:          0.00 :     0.00:      0.00:      0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC5, PSE-W1, continuing cra
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
 S   : M:  NUMBER      :        S0          :        S3          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :      (ksi)         :      (ksi)         :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          0.28 :     4.07:      4.11:     12.73:     12.86:
   2: 1:          0.44 :     3.30:      4.31:     10.31:     13.49:
   3: 1:          0.22 :     2.52:      4.56:      7.89:     14.26:
   4: 1:          0.06 :     1.75:      4.80:      5.35:     15.02:
   5: 1:          0.00 :     0.94:      5.05:      2.93:     15.79:
   6: 1:          0.00 :     0.16:      5.29:      0.51:     16.55:
```

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	0.00	0.00	0.00	0.00
2	1	0.44	0.00	0.00	0.00	0.00
3	1	0.22	0.00	0.00	0.00	0.00
4	1	0.06	0.00	0.00	0.00	0.00
5	1	0.00	0.00	0.00	0.00	0.00
6	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W1, continuing cra
MODEL: TC05

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.097112	6.577837
400	15		0.122532	6.659942
600	15		0.149420	6.769951
800	15		0.178808	6.955539
1000	15		0.212509	7.224002
1200	15		0.252405	7.540444
1400	15		0.301172	7.971287
1600	15		0.367386	8.784622

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No. 10
Step description:
of Block No. 8 of Schedule No. 1764
Crack Size c = 0.473968

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No. 10
Step description:
of Block No. 14 of Schedule No. 1777
Crack Size c = 0.512865

FATIGUE CRACK GROWTH ANALYSIS
-------Modified by FAI-------
DATE: 01-MAR-99 TIME: 15:52:46
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

CORNER CRACK CASE 2, PSE-W1 SA226 MS, crack in cap outbd WS100

GEOMETRY

MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t = 0.1250
Plate Width, W = 3.0000

```
Hole Diameter, D   =    0.1600
Hole-Center-to-Edge Dist., B =    0.3100
Poisson s ratio    =    0.30

FLAW SIZE:

a   (init.) =  0.5000E-01
c   (init.) =  0.5000E-01
a/c (init.) =   1.000



MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    6.1100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    6.1100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    6.1100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  5
```

```
Scale Factor for Stress S0:    4.6000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                   Block Case No.
From   -   To
    1   -     1                         1
    2   -     2                         2
    3   -     3                         5
    4   -     4                         1
    5   -     5                         3
    6   -     6                         5
    7   -     7                         1
    8   -     8                         3
    9   -     9                         5
   10   -    10                         1
   11   -    11                         3
   12   -    12                         5
   13   -    13                         1
   14   -    14                         4
   15   -    15                         5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :        S0         :        S1         :
 T   : A:    OF        :                   :                   :
 E   : T:  FATIGUE     :                   :                   :
 P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :   0.70:     1.30:    0.70:     1.30:
   2: 1:         0.09 :   0.60:     1.40:    0.60:     1.40:
   3: 1:         0.01 :   0.54:     1.46:    0.54:     1.46:
 S   : M:  NUMBER      :        S3         :        S          :
 T   : A:    OF        :                   :                   :
 E   : T:  FATIGUE     :                   :                   :
 P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :   0.70:     1.30:    0.00:     0.00:
   2: 1:         0.09 :   0.60:     1.40:    0.00:     0.00:
   3: 1:         0.01 :   0.54:     1.46:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S   : M:  NUMBER      :        S0         :        S1         :
 T   : A:    OF        :                   :                   :
 E   : T:  FATIGUE     :                   :                   :
 P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :   0.60:     1.20:   -0.30:     0.30:
   2: 1:         1.14 :   0.40:     1.40:   -0.50:     0.50:
   3: 1:         0.57 :   0.30:     1.50:   -0.60:     0.60:
   4: 1:         0.11 :   0.10:     1.70:   -0.80:     0.80:
   5: 1:         0.02 :  -0.10:     1.90:   -1.00:     1.00:
   6: 1:         0.01 :  -0.30:     2.10:   -1.20:     1.20:
   7: 1:         0.00 :  -0.50:     2.30:   -1.40:     1.40:
   8: 1:         0.00 :  -0.70:     2.50:   -1.60:     1.60:
   9: 1:         0.00 :  -0.90:     2.70:   -1.80:     1.80:
  10: 1:         0.00 :  -1.10:     2.90:   -2.00:     2.00:
 S   : M:  NUMBER      :        S3         :        S          :
 T   : A:    OF        :                   :                   :
 E   : T:  FATIGUE     :                   :                   :
 P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

1	1	9.57	0.60	1.20	0.00	0.00
2	1	1.14	0.40	1.40	0.00	0.00
3	1	0.57	0.30	1.50	0.00	0.00
4	1	0.11	0.10	1.70	0.00	0.00
5	1	0.02	-0.10	1.90	0.00	0.00
6	1	0.01	-0.30	2.10	0.00	0.00
7	1	0.00	-0.50	2.30	0.00	0.00
8	1	0.00	-0.70	2.50	0.00	0.00
9	1	0.00	-0.90	2.70	0.00	0.00
10	1	0.00	-1.10	2.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.60	1.20	-0.30	0.30
2	1	2.29	0.40	1.40	-0.50	0.50
3	1	1.14	0.30	1.50	-0.60	0.60
4	1	0.23	0.10	1.70	-0.80	0.80
5	1	0.04	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	19.14	0.60	1.20	0.00	0.00
2	1	2.29	0.40	1.40	0.00	0.00
3	1	1.14	0.30	1.50	0.00	0.00
4	1	0.23	0.10	1.70	0.00	0.00
5	1	0.04	-0.10	1.90	0.00	0.00
6	1	0.01	-0.30	2.10	0.00	0.00
7	1	0.00	-0.50	2.30	0.00	0.00
8	1	0.00	-0.70	2.50	0.00	0.00
9	1	0.00	-0.90	2.70	0.00	0.00
10	1	0.00	-1.10	2.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.60	1.20	-0.30	0.30
2	1	4.57	0.40	1.40	-0.50	0.50
3	1	2.29	0.30	1.50	-0.60	0.60
4	1	0.46	0.10	1.70	-0.80	0.80
5	1	0.08	-0.10	1.90	-1.00	1.00
6	1	0.02	-0.30	2.10	-1.20	1.20
7	1	0.01	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80

10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	38.29	0.60	1.20	0.00	0.00
2	1	4.57	0.40	1.40	0.00	0.00
3	1	2.29	0.30	1.50	0.00	0.00
4	1	0.46	0.10	1.70	0.00	0.00
5	1	0.08	-0.10	1.90	0.00	0.00
6	1	0.02	-0.30	2.10	0.00	0.00
7	1	0.01	-0.50	2.30	0.00	0.00
8	1	0.00	-0.70	2.50	0.00	0.00
9	1	0.00	-0.90	2.70	0.00	0.00
10	1	0.00	-1.10	2.90	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)

1:	1:	1.90 :	-0.70:	-1.30:	0.00:	0.00:
2:	1:	0.09 :	-0.60:	-1.40:	0.00:	0.00:
3:	1:	0.01 :	-0.54:	-1.46:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	9.57 :	3.67:	7.33:	0.00:	0.00:
2:	1:	1.14 :	2.44:	8.55:	0.00:	0.00:
3:	1:	0.57 :	1.83:	9.17:	0.00:	0.00:
4:	1:	0.11 :	0.61:	10.39:	0.00:	0.00:
5:	1:	0.02 :	-0.61:	11.61:	0.00:	0.00:
6:	1:	0.01 :	-1.83:	12.83:	0.00:	0.00:
7:	1:	0.00 :	-3.05:	14.05:	0.00:	0.00:
8:	1:	0.00 :	-4.28:	15.28:	0.00:	0.00:
9:	1:	0.00 :	-5.50:	16.50:	0.00:	0.00:
10:	1:	0.00 :	-6.72:	17.72:	0.00:	0.00:

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	9.57 :	0.00:	0.00:	0.00:	0.00:
2:	1:	1.14 :	0.00:	0.00:	0.00:	0.00:
3:	1:	0.57 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.11 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.02 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:
7:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
8:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
9:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
10:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	19.14 :	3.67:	7.33:	0.00:	0.00:
2:	1:	2.29 :	2.44:	8.55:	0.00:	0.00:
3:	1:	1.14 :	1.83:	9.17:	0.00:	0.00:
4:	1:	0.23 :	0.61:	10.39:	0.00:	0.00:
5:	1:	0.04 :	-0.61:	11.61:	0.00:	0.00:
6:	1:	0.01 :	-1.83:	12.83:	0.00:	0.00:
7:	1:	0.00 :	-3.05:	14.05:	0.00:	0.00:
8:	1:	0.00 :	-4.28:	15.28:	0.00:	0.00:
9:	1:	0.00 :	-5.50:	16.50:	0.00:	0.00:

```
 10: 1:          0.00 :   -6.72:   17.72:    0.00:    0.00:
S   : M:  NUMBER      :       S3          :        S          :
T   : A:    OF        :                   :                   :
E   : T:  FATIGUE     :      (ksi)        :      (ksi)        :
P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
  1: 1:         19.14 :    0.00:    0.00:    0.00:    0.00:
  2: 1:          2.29 :    0.00:    0.00:    0.00:    0.00:
  3: 1:          1.14 :    0.00:    0.00:    0.00:    0.00:
  4: 1:          0.23 :    0.00:    0.00:    0.00:    0.00:
  5: 1:          0.04 :    0.00:    0.00:    0.00:    0.00:
  6: 1:          0.01 :    0.00:    0.00:    0.00:    0.00:
  7: 1:          0.00 :    0.00:    0.00:    0.00:    0.00:
  8: 1:          0.00 :    0.00:    0.00:    0.00:    0.00:
  9: 1:          0.00 :    0.00:    0.00:    0.00:    0.00:
 10: 1:          0.00 :    0.00:    0.00:    0.00:    0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER      :       S0          :       S1          :
T   : A:    OF        :                   :                   :
E   : T:  FATIGUE     :      (ksi)        :      (ksi)        :
P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
  1: 1:         38.29 :    3.67:    7.33:    0.00:    0.00:
  2: 1:          4.57 :    2.44:    8.55:    0.00:    0.00:
  3: 1:          2.29 :    1.83:    9.17:    0.00:    0.00:
  4: 1:          0.46 :    0.61:   10.39:    0.00:    0.00:
  5: 1:          0.08 :   -0.61:   11.61:    0.00:    0.00:
  6: 1:          0.02 :   -1.83:   12.83:    0.00:    0.00:
  7: 1:          0.01 :   -3.05:   14.05:    0.00:    0.00:
  8: 1:          0.00 :   -4.28:   15.28:    0.00:    0.00:
  9: 1:          0.00 :   -5.50:   16.50:    0.00:    0.00:
 10: 1:          0.00 :   -6.72:   17.72:    0.00:    0.00:
S   : M:  NUMBER      :       S3          :        S          :
T   : A:    OF        :                   :                   :
E   : T:  FATIGUE     :      (ksi)        :      (ksi)        :
P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
  1: 1:         38.29 :    0.00:    0.00:    0.00:    0.00:
  2: 1:          4.57 :    0.00:    0.00:    0.00:    0.00:
  3: 1:          2.29 :    0.00:    0.00:    0.00:    0.00:
  4: 1:          0.46 :    0.00:    0.00:    0.00:    0.00:
  5: 1:          0.08 :    0.00:    0.00:    0.00:    0.00:
  6: 1:          0.02 :    0.00:    0.00:    0.00:    0.00:
  7: 1:          0.01 :    0.00:    0.00:    0.00:    0.00:
  8: 1:          0.00 :    0.00:    0.00:    0.00:    0.00:
  9: 1:          0.00 :    0.00:    0.00:    0.00:    0.00:
 10: 1:          0.00 :    0.00:    0.00:    0.00:    0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER      :       S0          :       S1          :
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
T   : A:   OF          :                     :                     :
E   : T:  FATIGUE      :      (ksi)          :      (ksi)          :
P   : L:  CYCLES       :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:---------------:---------:-----------:---------:-----------:
  1: 1:          0.28 :   4.60:      4.65:    0.00:      0.00:
  2: 1:          0.44 :   3.73:      4.88:    0.00:      0.00:
  3: 1:          0.22 :   2.85:      5.15:    0.00:      0.00:
  4: 1:          0.06 :   1.98:      5.43:    0.00:      0.00:
  5: 1:          0.00 :   1.06:      5.70:    0.00:      0.00:
  6: 1:          0.00 :   0.18:      5.98:    0.00:      0.00:
S   : M:  NUMBER       :       S3            :       S             :
T   : A:   OF          :                     :                     :
E   : T:  FATIGUE      :      (ksi)          :      (ksi)          :
P   : L:  CYCLES       :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:---------------:---------:-----------:---------:-----------:
  1: 1:          0.28 :   0.00:      0.00:    0.00:      0.00:
  2: 1:          0.44 :   0.00:      0.00:    0.00:      0.00:
  3: 1:          0.22 :   0.00:      0.00:    0.00:      0.00:
  4: 1:          0.06 :   0.00:      0.00:    0.00:      0.00:
  5: 1:          0.00 :   0.00:      0.00:    0.00:      0.00:
  6: 1:          0.00 :   0.00:      0.00:    0.00:      0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block	Step	Final Flaw Size a	c	K max a-tip	c-tip
200	15		0.051451	0.050403	3.625080	2.846104
400	15		0.052925	0.050842	3.636784	2.885394
600	15		0.054420	0.051317	3.648608	2.923949
800	15		0.055938	0.051827	3.660599	2.961822
1000	15		0.057479	0.052375	3.672800	2.999071
1200	15		0.059044	0.052961	3.685251	3.035757
1400	15		0.060634	0.053585	3.697988	3.071943
1600	15		0.062249	0.054248	3.711043	3.107696
1800	15		0.063891	0.054953	3.724445	3.143084
2000	15		0.065561	0.055698	3.738218	3.178178
2200	15		0.067259	0.056487	3.752385	3.213050
2400	15		0.068987	0.057319	3.766966	3.247774
2600	15		0.070746	0.058197	3.781978	3.282427
2800	15		0.072538	0.059122	3.797435	3.317086
3000	15		0.074364	0.060095	3.813352	3.351832
3200	15		0.076225	0.061119	3.829739	3.386746
3400	15		0.078123	0.062195	3.846608	3.421914
3600	15		0.080060	0.063327	3.863969	3.457423
3800	15		0.082038	0.064515	3.881831	3.493362
4000	15		0.084057	0.065763	3.900203	3.529824
4200	15		0.086121	0.067075	3.919094	3.566907
4400	15		0.088231	0.068453	3.938514	3.604711
4600	15		0.090388	0.069901	3.958471	3.643345
4800	15		0.092597	0.071424	3.978971	3.682921
5000	15		0.094857	0.073026	4.000024	3.723557
5200	15		0.097173	0.074712	4.021637	3.765380
5400	15		0.099546	0.076489	4.043816	3.808524
5600	15		0.101978	0.078362	4.066567	3.853130
5800	15		0.104474	0.080339	4.089895	3.899350
6000	15		0.107035	0.082429	4.113799	3.947346
6200	15		0.109664	0.084640	4.138276	3.997289

6400	15	0.112364	0.086983	4.163313	4.049360
6600	15	0.115139	0.089470	4.188891	4.103750
6800	15	0.117992	0.092114	4.214976	4.160659
7000	15	0.120925	0.094930	4.241516	4.220292
7200	15	0.123941	0.097935	4.268434	4.282852

```
Transition to 1-d solution, TC03:
a =    0.1250        t =    0.1250
at Cycle No.          2.29  of Load Step No.   3
Step description:
of Block No.      14  of Schedule No.    7269
Crack Size:  c =  0.990185E-01 ,  a/c =    1.26240
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
7400	15		0.103140	4.780471
7600	15		0.110000	4.908498
7800	15		0.117751	5.067268
8000	15		0.126757	5.273991
8200	15		0.137697	5.565063
8400	15		0.152143	6.040450
8600	15		0.176124	7.222344

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     51.94      K ref =     0.000      K cr =     51.83
at the very beginning of Load Step No.    9
Step description:
of Block No.       5  of Schedule No.    8697
Crack Size      c =  0.222215


                  FATIGUE CRACK GROWTH ANALYSIS
                  -------Modified by FAI-------
                DATE: 25-MAR-99    TIME: 09:39:20
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 11, PSE-W1 SA226 MS, crack in cap WS112 (

GEOMETRY
--------
MODEL: TC11-Corner crack in plate or bar (2D)

Plate Thickness, t =    0.1250
  "   Width, W      =    3.0000
Hole Diameter, D    =    0.1600
Hole-Center-to-Edge Dist., B =    0.3100
2ND AREA, AREATC11 =    0.7350
2ND M. INERTIA =    0.2580
2ND C.G. =    1.4520

FLAW SIZE:

c   (init.) =  0.9900E-01


MATERIAL
--------

MATL 1:
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
        1        2014T6511 EXTRUSION T-L

 Material Properties:

 :Matl: UTS :  YS  : K1e  : K1c  : Ak : Bk : Thk  : Kc  : KIscc:
 : No.:     :      :      :      :    :    :      :     :      :
 :----:------:------:------:------:-----:-----:-------:------:------:
 :  1 : 74.0: 65.0: 27.0: 27.0: 1.00: 1.00: 0.125: 51.8:      :

 :Matl:---------- Crack Growth Eqn Constants -------------:
 : No.:    C     :  n  :  p  :  q :  DKo : Rcl :Alpha:Smax/:
 :    :          :     :     :    :      :     :     :SIGo :
 :----:---------:-----:----:----:------:------:-----:-----:
 :  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

 MODEL: TC11

 FATIGUE SCHEDULE BLOCK INPUT TABLE
 ----------------------------------
 STD

 [Note: Stress = Input Value * Stress Factor]

 Stress Scaling Factors for Block Case:  1

 Scale Factor for Stress S0:    -1.0000
 Scale Factor for Stress S3:    -1.0000

 Stress Scaling Factors for Block Case:  2

 Scale Factor for Stress S0:     6.1100
 Scale Factor for Stress S3:     0.0000

 Stress Scaling Factors for Block Case:  3

 Scale Factor for Stress S0:     6.1100
 Scale Factor for Stress S3:     0.0000

 Stress Scaling Factors for Block Case:  4

 Scale Factor for Stress S0:     6.1100
 Scale Factor for Stress S3:     0.0000

 Stress Scaling Factors for Block Case:  5

 Scale Factor for Stress S0:     4.6000
 Scale Factor for Stress S3:     0.0000

 Total No. of Blocks in Schedule =    15

    Block Number and Case Correspondences
  Block Number                    Block Case No.
 From    -    To
    1    -     1                       1
    2    -     2                       2
    3    -     3                       5
    4    -     4                       1
    5    -     5                       3
    6    -     6                       5
    7    -     7                       1
    8    -     8                       3
    9    -     9                       5
   10    -    10                       1
   11    -    11                       3
   12    -    12                       5
   13    -    13                       1
   14    -    14                       4
```

15 - 15 5

BLOCK CASE NO. 1

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	9.57	0.70	1.30	-0.30	0.30
2	1	1.14	0.50	1.50	-0.50	0.50
3	1	0.57	0.40	1.60	-0.60	0.60
4	1	0.11	0.20	1.80	-0.80	0.80
5	1	0.02	0.00	2.00	-1.00	1.00
6	1	0.01	-0.20	2.20	-1.20	1.20
7	1	0.00	-0.40	2.40	-1.40	1.40
8	1	0.00	-0.60	2.60	-1.60	1.60
9	1	0.00	-0.80	2.80	-1.80	1.80
10	1	0.00	-1.00	3.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	0.70	1.30	-0.30	0.30
2	1	2.29	0.50	1.50	-0.50	0.50
3	1	1.14	0.40	1.60	-0.60	0.60
4	1	0.23	0.20	1.80	-0.80	0.80
5	1	0.04	0.00	2.00	-1.00	1.00
6	1	0.01	-0.20	2.20	-1.20	1.20
7	1	0.00	-0.40	2.40	-1.40	1.40
8	1	0.00	-0.60	2.60	-1.60	1.60
9	1	0.00	-0.80	2.80	-1.80	1.80
10	1	0.00	-1.00	3.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	0.70	1.30	-0.30	0.30
2	1	4.57	0.50	1.50	-0.50	0.50
3	1	2.29	0.40	1.60	-0.60	0.60

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

4:	1:	0.46 :	0.20:	1.80:	-0.80:	0.80:
5:	1:	0.08 :	0.00:	2.00:	-1.00:	1.00:
6:	1:	0.02 :	-0.20:	2.20:	-1.20:	1.20:
7:	1:	0.01 :	-0.40:	2.40:	-1.40:	1.40:
8:	1:	0.00 :	-0.60:	2.60:	-1.60:	1.60:
9:	1:	0.00 :	-0.80:	2.80:	-1.80:	1.80:
10:	1:	0.00 :	-1.00:	3.00:	-2.00:	2.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	0.28 :	1.00:	1.01:	1.00:	1.01:
2:	1:	0.44 :	0.81:	1.06:	0.81:	1.06:
3:	1:	0.22 :	0.62:	1.12:	0.62:	1.12:
4:	1:	0.06 :	0.43:	1.18:	0.42:	1.18:
5:	1:	0.00 :	0.23:	1.24:	0.23:	1.24:
6:	1:	0.00 :	0.04:	1.30:	0.04:	1.30:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	1.90 :	-0.70:	-1.30:	-0.70:	-1.30:
2:	1:	0.09 :	-0.60:	-1.40:	-0.60:	-1.40:
3:	1:	0.01 :	-0.54:	-1.46:	-0.54:	-1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	9.57 :	4.28:	7.94:	0.00:	0.00:
2:	1:	1.14 :	3.06:	9.17:	0.00:	0.00:
3:	1:	0.57 :	2.44:	9.78:	0.00:	0.00:
4:	1:	0.11 :	1.22:	11.00:	0.00:	0.00:
5:	1:	0.02 :	0.00:	12.22:	0.00:	0.00:
6:	1:	0.01 :	-1.22:	13.44:	0.00:	0.00:
7:	1:	0.00 :	-2.44:	14.66:	0.00:	0.00:
8:	1:	0.00 :	-3.67:	15.89:	0.00:	0.00:
9:	1:	0.00 :	-4.89:	17.11:	0.00:	0.00:
10:	1:	0.00 :	-6.11:	18.33:	0.00:	0.00:

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	4.28	7.94	0.00	0.00
2	1	2.29	3.06	9.17	0.00	0.00
3	1	1.14	2.44	9.78	0.00	0.00
4	1	0.23	1.22	11.00	0.00	0.00
5	1	0.04	0.00	12.22	0.00	0.00
6	1	0.01	-1.22	13.44	0.00	0.00
7	1	0.00	-2.44	14.66	0.00	0.00
8	1	0.00	-3.67	15.89	0.00	0.00
9	1	0.00	-4.89	17.11	0.00	0.00
10	1	0.00	-6.11	18.33	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	4.28	7.94	0.00	0.00
2	1	4.57	3.06	9.17	0.00	0.00
3	1	2.29	2.44	9.78	0.00	0.00
4	1	0.46	1.22	11.00	0.00	0.00
5	1	0.08	0.00	12.22	0.00	0.00
6	1	0.02	-1.22	13.44	0.00	0.00
7	1	0.01	-2.44	14.66	0.00	0.00
8	1	0.00	-3.67	15.89	0.00	0.00
9	1	0.00	-4.89	17.11	0.00	0.00
10	1	0.00	-6.11	18.33	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	4.60	4.65	0.00	0.00
2	1	0.44	3.73	4.88	0.00	0.00

```
3: 1:        0.22 :    2.85:    5.15:    0.00:    0.00:
4: 1:        0.06 :    1.98:    5.43:    0.00:    0.00:
5: 1:        0.00 :    1.06:    5.70:    0.00:    0.00:
6: 1:        0.00 :    0.18:    5.98:    0.00:    0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 THROUGH CRACK CASE 11, PSE-
MODEL: TC11

ANALYSIS RESULTS:
-----------------


 Schedl    Block           Final Flaw Size           K max
                  Step           c                   c-tip
   200      15               0.105084              4.702629
   400      15               0.111781              4.820059
   600      15               0.119282              4.964483
   800      15               0.127893              5.150143
  1000      15               0.138168              5.405927
  1200      15               0.151306              5.805199
  1400      15               0.171142              6.651284

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     52.37     K ref =     0.000     K cr =     51.83
at Cycle No.          0.00   of Load Step No.      7
Step description:
of Block No.     14   of Schedule No.     1544
Crack Size     c =  0.224552


                 FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
                DATE: 25-MAR-99    TIME: 08:56:06
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W1 SA226 MS, crack in cap WS112 (Ti

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    3.0000
Hole Diameter, D   =    0.1600
Hole-Center-to-Edge Dist., B =    0.3100
Poisson s ratio    =    0.30

FLAW SIZE:

a   (init.) =  0.5000E-01
c   (init.) =  0.5000E-01
a/c (init.) =   1.000



MATERIAL
--------
```

```
MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl: UTS  :  YS  : K1e  : K1c  : Ak  : Bk  :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 : 74.0: 65.0:  27.0:  27.0: 1.00: 1.00: 0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    5.2000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    5.2000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    5.2000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.9000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
  Block Number                  Block Case No.
From   -   To
    1  -    1                         1
    2  -    2                         2
    3  -    3                         5
    4  -    4                         1
    5  -    5                         3
    6  -    6                         5
    7  -    7                         1
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	1.90	0.70:	1.30:	0.70:	1.30:
2:	1:	0.09	0.60:	1.40:	0.60:	1.40:
3:	1:	0.01	0.54:	1.46:	0.54:	1.46:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	1.90	0.70:	1.30:	0.00:	0.00:
2:	1:	0.09	0.60:	1.40:	0.00:	0.00:
3:	1:	0.01	0.54:	1.46:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	9.57	0.70:	1.30:	-0.30:	0.30:
2:	1:	1.14	0.50:	1.50:	-0.50:	0.50:
3:	1:	0.57	0.40:	1.60:	-0.60:	0.60:
4:	1:	0.11	0.20:	1.80:	-0.80:	0.80:
5:	1:	0.02	0.00:	2.00:	-1.00:	1.00:
6:	1:	0.01	-0.20:	2.20:	-1.20:	1.20:
7:	1:	0.00	-0.40:	2.40:	-1.40:	1.40:
8:	1:	0.00	-0.60:	2.60:	-1.60:	1.60:
9:	1:	0.00	-0.80:	2.80:	-1.80:	1.80:
10:	1:	0.00	-1.00:	3.00:	-2.00:	2.00:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	9.57	-0.30:	0.30:	0.00:	0.00:
2:	1:	1.14	-0.50:	0.50:	0.00:	0.00:
3:	1:	0.57	-0.60:	0.60:	0.00:	0.00:
4:	1:	0.11	-0.80:	0.80:	0.00:	0.00:
5:	1:	0.02	-1.00:	1.00:	0.00:	0.00:
6:	1:	0.01	-1.20:	1.20:	0.00:	0.00:
7:	1:	0.00	-1.40:	1.40:	0.00:	0.00:
8:	1:	0.00	-1.60:	1.60:	0.00:	0.00:
9:	1:	0.00	-1.80:	1.80:	0.00:	0.00:
10:	1:	0.00	-2.00:	2.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.70	1.30	-0.30	0.30
2	1	2.29	0.50	1.50	-0.50	0.50
3	1	1.14	0.40	1.60	-0.60	0.60
4	1	0.23	0.20	1.80	-0.80	0.80
5	1	0.04	0.00	2.00	-1.00	1.00
6	1	0.01	-0.20	2.20	-1.20	1.20
7	1	0.00	-0.40	2.40	-1.40	1.40
8	1	0.00	-0.60	2.60	-1.60	1.60
9	1	0.00	-0.80	2.80	-1.80	1.80
10	1	0.00	-1.00	3.00	-2.00	2.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	19.14	-0.30	0.30	0.00	0.00
2	1	2.29	-0.50	0.50	0.00	0.00
3	1	1.14	-0.60	0.60	0.00	0.00
4	1	0.23	-0.80	0.80	0.00	0.00
5	1	0.04	-1.00	1.00	0.00	0.00
6	1	0.01	-1.20	1.20	0.00	0.00
7	1	0.00	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.70	1.30	-0.30	0.30
2	1	4.57	0.50	1.50	-0.50	0.50
3	1	2.29	0.40	1.60	-0.60	0.60
4	1	0.46	0.20	1.80	-0.80	0.80
5	1	0.08	0.00	2.00	-1.00	1.00
6	1	0.02	-0.20	2.20	-1.20	1.20
7	1	0.01	-0.40	2.40	-1.40	1.40
8	1	0.00	-0.60	2.60	-1.60	1.60
9	1	0.00	-0.80	2.80	-1.80	1.80
10	1	0.00	-1.00	3.00	-2.00	2.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	38.29	-0.30	0.30	0.00	0.00
2	1	4.57	-0.50	0.50	0.00	0.00
3	1	2.29	-0.60	0.60	0.00	0.00
4	1	0.46	-0.80	0.80	0.00	0.00
5	1	0.08	-1.00	1.00	0.00	0.00
6	1	0.02	-1.20	1.20	0.00	0.00
7	1	0.01	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S T E	M A T	NUMBER OF FATIGUE	S0 (ksi)	S1 (ksi)

P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	9.57	3.64	6.76	0.00	0.00
2	1	1.14	2.60	7.80	0.00	0.00
3	1	0.57	2.08	8.32	0.00	0.00
4	1	0.11	1.04	9.36	0.00	0.00
5	1	0.02	0.00	10.40	0.00	0.00
6	1	0.01	-1.04	11.44	0.00	0.00
7	1	0.00	-2.08	12.48	0.00	0.00
8	1	0.00	-3.12	13.52	0.00	0.00
9	1	0.00	-4.16	14.56	0.00	0.00
10	1	0.00	-5.20	15.60	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	0.00	0.00	0.00	0.00
2	1	1.14	0.00	0.00	0.00	0.00
3	1	0.57	0.00	0.00	0.00	0.00
4	1	0.11	0.00	0.00	0.00	0.00
5	1	0.02	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	3.64	6.76	0.00	0.00
2	1	2.29	2.60	7.80	0.00	0.00
3	1	1.14	2.08	8.32	0.00	0.00
4	1	0.23	1.04	9.36	0.00	0.00
5	1	0.04	0.00	10.40	0.00	0.00
6	1	0.01	-1.04	11.44	0.00	0.00
7	1	0.00	-2.08	12.48	0.00	0.00
8	1	0.00	-3.12	13.52	0.00	0.00
9	1	0.00	-4.16	14.56	0.00	0.00
10	1	0.00	-5.20	15.60	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00
2	1	2.29	0.00	0.00	0.00	0.00
3	1	1.14	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.04	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	3.64	6.76	0.00	0.00
2	1	4.57	2.60	7.80	0.00	0.00
3	1	2.29	2.08	8.32	0.00	0.00
4	1	0.46	1.04	9.36	0.00	0.00
5	1	0.08	0.00	10.40	0.00	0.00
6	1	0.02	-1.04	11.44	0.00	0.00
7	1	0.01	-2.08	12.48	0.00	0.00
8	1	0.00	-3.12	13.52	0.00	0.00
9	1	0.00	-4.16	14.56	0.00	0.00
10	1	0.00	-5.20	15.60	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	38.29	0.00	0.00	0.00	0.00
2	1	4.57	0.00	0.00	0.00	0.00
3	1	2.29	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.08	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.28	3.90	3.94	0.00	0.00
2	1	0.44	3.16	4.13	0.00	0.00
3	1	0.22	2.42	4.37	0.00	0.00
4	1	0.06	1.68	4.60	0.00	0.00
5	1	0.00	0.90	4.84	0.00	0.00
6	1	0.00	0.16	5.07	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	0.00	0.00	0.00	0.00

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

2: 1:	0.44 :	0.00:	0.00:	0.00:	0.00:
3: 1:	0.22 :	0.00:	0.00:	0.00:	0.00:
4: 1:	0.06 :	0.00:	0.00:	0.00:	0.00:
5: 1:	0.00 :	0.00:	0.00:	0.00:	0.00:
6: 1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15	0.050740	0.050157	3.067881	2.397059
400	15	0.051484	0.050321	3.072147	2.414917
600	15	0.052234	0.050492	3.076380	2.432598
800	15	0.052989	0.050670	3.080589	2.450104
1000	15	0.053749	0.050866	3.084956	2.467313
1200	15	0.054514	0.051077	3.089448	2.484268
1400	15	0.055284	0.051300	3.094033	2.501009
1600	15	0.056060	0.051536	3.098702	2.517555
1800	15	0.056842	0.051784	3.103455	2.533921
2000	15	0.057630	0.052043	3.108289	2.550119
2200	15	0.058423	0.052313	3.113209	2.566160
2400	15	0.059223	0.052595	3.118214	2.582055
2600	15	0.060029	0.052888	3.123309	2.597814
2800	15	0.060841	0.053193	3.128494	2.613447
3000	15	0.061660	0.053509	3.133774	2.628963
3200	15	0.062485	0.053836	3.139150	2.644373
3400	15	0.063317	0.054175	3.144624	2.659685
3600	15	0.064156	0.054526	3.150199	2.674909
3800	15	0.065003	0.054889	3.155877	2.690056
4000	15	0.065856	0.055263	3.161660	2.705133
4200	15	0.066717	0.055649	3.167550	2.720151
4400	15	0.067586	0.056048	3.173549	2.735120
4600	15	0.068463	0.056459	3.179658	2.750048
4800	15	0.069348	0.056882	3.185880	2.764946
5000	15	0.070241	0.057318	3.192214	2.779824
5200	15	0.071142	0.057767	3.198664	2.794690
5400	15	0.072053	0.058229	3.205229	2.809556
5600	15	0.072972	0.058704	3.211912	2.824430
5800	15	0.073900	0.059192	3.218713	2.839323
6000	15	0.074838	0.059695	3.225633	2.854245
6200	15	0.075785	0.060211	3.232673	2.869207
6400	15	0.076742	0.060742	3.239835	2.884217
6600	15	0.077710	0.061287	3.247119	2.899288
6800	15	0.078687	0.061847	3.254526	2.914430
7000	15	0.079675	0.062422	3.262056	2.929652
7200	15	0.080674	0.063012	3.269712	2.944968
7400	15	0.081684	0.063619	3.277493	2.960386
7600	15	0.082706	0.064242	3.285400	2.975919
7800	15	0.083739	0.064881	3.293434	2.991579
8000	15	0.084784	0.065538	3.301596	3.007377
8200	15	0.085841	0.066212	3.309887	3.023325
8400	15	0.086911	0.066904	3.318307	3.039436
8600	15	0.087993	0.067614	3.326857	3.055722
8800	15	0.089089	0.068344	3.335539	3.072197
9000	15	0.090198	0.069094	3.344353	3.088873
9200	15	0.091321	0.069863	3.353299	3.105765
9400	15	0.092458	0.070654	3.362379	3.122887

9600	15	0.093609	0.071466	3.371594	3.140252
9800	15	0.094776	0.072300	3.380945	3.157877
10000	15	0.095957	0.073157	3.390431	3.175777

MODEL: CC02

ANALYSIS RESULTS (contd.)

Schdl	Block Step	Final Flaw Size a	c	K max a-tip	c-tip
10200	15	0.097154	0.074038	3.400055	3.193967
10400	15	0.098367	0.074944	3.409817	3.212464
10600	15	0.099596	0.075875	3.419717	3.231286
10800	15	0.100842	0.076833	3.429757	3.250449
11000	15	0.102105	0.077819	3.439936	3.269973
11200	15	0.103385	0.078833	3.450257	3.289876
11400	15	0.104683	0.079877	3.460717	3.310177
11600	15	0.106000	0.080952	3.471318	3.330898
11800	15	0.107335	0.082060	3.482060	3.352058
12000	15	0.108689	0.083201	3.492942	3.373680
12200	15	0.110064	0.084377	3.503962	3.395786
12400	15	0.111458	0.085591	3.515120	3.418399
12600	15	0.112873	0.086843	3.526413	3.441542
12800	15	0.114308	0.088135	3.537838	3.465241
13000	15	0.115766	0.089469	3.549393	3.489519
13200	15	0.117245	0.090848	3.561073	3.514403
13400	15	0.118747	0.092274	3.572871	3.539918
13600	15	0.120271	0.093748	3.584780	3.566092
13800	15	0.121819	0.095274	3.596792	3.592949
14000	15	0.123391	0.096853	3.608897	3.620517
14200	15	0.124988	0.098490	3.621081	3.648821

Transition to 1-d solution, TC03:
a = 0.1250 t = 0.1250
at Cycle No. 19.14 of Load Step No. 1
Step description:
of Block No. 11 of Schedule No. 14202
Crack Size: c = 0.985029E-01 , a/c = 1.26900

Schdl	Block Step	Final Flaw Size c	K max c-tip
14400	15	0.101755	4.032176
14600	15	0.105211	4.084816
14800	15	0.108873	4.143076
15000	15	0.112774	4.208174
15200	15	0.116958	4.281754
15400	15	0.121483	4.366112
15600	15	0.126427	4.464584
15800	15	0.131901	4.582271
16000	15	0.138076	4.727523
16200	15	0.145228	4.915364
16400	15	0.153867	5.176949
16600	15	0.165140	5.594676
16800	15	0.183064	6.550162

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max = 53.09 K ref = 0.000 K cr = 51.83
at the very beginning of Load Step No. 10
Step description:
of Block No. 5 of Schedule No. 16919
Crack Size c = 0.223338

```
                    FATIGUE CRACK GROWTH ANALYSIS
                   -------Modified by FAI-------
                 DATE: 25-MAR-99    TIME: 09:35:56
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 11, PSE-W1 SA226 MS, crack in cap WS112 (

GEOMETRY
--------
MODEL: TC11-Corner crack in plate or bar (2D)

Plate Thickness, t =     0.1250
  "   Width, W     =     3.0000
Hole Diameter, D   =     0.1600
Hole-Center-to-Edge Dist., B =     0.3100
2ND AREA, AREATC11 =     0.7350
2ND M. INERTIA =     0.2580
2ND C.G. =     1.4520

FLAW SIZE:

c   (init.) =  0.9849E-01



MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p  :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :     :    :      :      :     :SIGo :
:----:----------:-----:-----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC11

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    5.2000
Scale Factor for Stress S3:    0.0000
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 5.2000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 5.2000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 3.9000
Scale Factor for Stress S3: 0.0000

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	9.57	0.70	1.30	-0.30	0.30
2	1	1.14	0.50	1.50	-0.50	0.50
3	1	0.57	0.40	1.60	-0.60	0.60
4	1	0.11	0.20	1.80	-0.80	0.80
5	1	0.02	0.00	2.00	-1.00	1.00
6	1	0.01	-0.20	2.20	-1.20	1.20
7	1	0.00	-0.40	2.40	-1.40	1.40
8	1	0.00	-0.60	2.60	-1.60	1.60
9	1	0.00	-0.80	2.80	-1.80	1.80
10	1	0.00	-1.00	3.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	0.70	1.30	-0.30	0.30
2	1	2.29	0.50	1.50	-0.50	0.50
3	1	1.14	0.40	1.60	-0.60	0.60
4	1	0.23	0.20	1.80	-0.80	0.80
5	1	0.04	0.00	2.00	-1.00	1.00
6	1	0.01	-0.20	2.20	-1.20	1.20
7	1	0.00	-0.40	2.40	-1.40	1.40
8	1	0.00	-0.60	2.60	-1.60	1.60
9	1	0.00	-0.80	2.80	-1.80	1.80
10	1	0.00	-1.00	3.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	0.70	1.30	-0.30	0.30
2	1	4.57	0.50	1.50	-0.50	0.50
3	1	2.29	0.40	1.60	-0.60	0.60
4	1	0.46	0.20	1.80	-0.80	0.80
5	1	0.08	0.00	2.00	-1.00	1.00
6	1	0.02	-0.20	2.20	-1.20	1.20
7	1	0.01	-0.40	2.40	-1.40	1.40
8	1	0.00	-0.60	2.60	-1.60	1.60
9	1	0.00	-0.80	2.80	-1.80	1.80
10	1	0.00	-1.00	3.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	1.90	-0.70:	-1.30:	-0.70:	-1.30:
2:	1:	0.09	-0.60:	-1.40:	-0.60:	-1.40:
3:	1:	0.01	-0.54:	-1.46:	-0.54:	-1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	9.57	3.64:	6.76:	0.00:	0.00:
2:	1:	1.14	2.60:	7.80:	0.00:	0.00:
3:	1:	0.57	2.08:	8.32:	0.00:	0.00:
4:	1:	0.11	1.04:	9.36:	0.00:	0.00:
5:	1:	0.02	0.00:	10.40:	0.00:	0.00:
6:	1:	0.01	-1.04:	11.44:	0.00:	0.00:
7:	1:	0.00	-2.08:	12.48:	0.00:	0.00:
8:	1:	0.00	-3.12:	13.52:	0.00:	0.00:
9:	1:	0.00	-4.16:	14.56:	0.00:	0.00:
10:	1:	0.00	-5.20:	15.60:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	19.14	3.64:	6.76:	0.00:	0.00:
2:	1:	2.29	2.60:	7.80:	0.00:	0.00:
3:	1:	1.14	2.08:	8.32:	0.00:	0.00:
4:	1:	0.23	1.04:	9.36:	0.00:	0.00:
5:	1:	0.04	0.00:	10.40:	0.00:	0.00:
6:	1:	0.01	-1.04:	11.44:	0.00:	0.00:
7:	1:	0.00	-2.08:	12.48:	0.00:	0.00:
8:	1:	0.00	-3.12:	13.52:	0.00:	0.00:
9:	1:	0.00	-4.16:	14.56:	0.00:	0.00:
10:	1:	0.00	-5.20:	15.60:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	3.64	6.76	0.00	0.00
2	1	4.57	2.60	7.80	0.00	0.00
3	1	2.29	2.08	8.32	0.00	0.00
4	1	0.46	1.04	9.36	0.00	0.00
5	1	0.08	0.00	10.40	0.00	0.00
6	1	0.02	-1.04	11.44	0.00	0.00
7	1	0.01	-2.08	12.48	0.00	0.00
8	1	0.00	-3.12	13.52	0.00	0.00
9	1	0.00	-4.16	14.56	0.00	0.00
10	1	0.00	-5.20	15.60	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	3.90	3.94	0.00	0.00
2	1	0.44	3.16	4.13	0.00	0.00
3	1	0.22	2.42	4.37	0.00	0.00
4	1	0.06	1.68	4.60	0.00	0.00
5	1	0.00	0.90	4.84	0.00	0.00
6	1	0.00	0.16	5.07	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.101455	3.936477
400	15		0.104558	3.979542
600	15		0.107814	4.026573
800	15		0.111246	4.078298
1000	15		0.114880	4.135656
1200	15		0.118748	4.199888
1400	15		0.122895	4.272683
1600	15		0.127376	4.356411
1800	15		0.132272	4.454548
2000	15		0.137694	4.572464
2200	15		0.143815	4.719071
2400	15		0.150924	4.910736
2600	15		0.159560	5.182484
2800	15		0.170999	5.632653
3000	15		0.190392	6.813172

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max = 52.94 K ref = 0.000 K cr = 51.83
at the very beginning of Load Step No. 9
Step description:
of Block No. 5 of Schedule No. 3086
Crack Size c = 0.224746

FATIGUE CRACK GROWTH ANALYSIS
-------Modified by FAI-------
DATE: 25-MAR-99 TIME: 09:05:28
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

CORNER CRACK CASE 2, PSE-W1 SA226 MS, crack in cap WS125 (Ti

GEOMETRY

MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t = 0.1250
Plate Width, W = 3.0000
Hole Diameter, D = 0.1600
Hole-Center-to-Edge Dist., B = 0.3100
Poisson s ratio = 0.30

FLAW SIZE:

a (init.) = 0.5000E-01
c (init.) = 0.5000E-01
a/c (init.) = 1.000

MATERIAL

MATL 1:
1 2014T6511 EXTRUSION T-L

Material Properties:

Matl: No.	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	74.0	65.0	27.0	27.0	1.00	1.00	0.125	51.8	

:Matl:---------- Crack Growth Eqn Constants -------------:

Matl: No.	C	n	p	q	DKo	Rcl	Alpha	Smax/SIGo
1	0.200D-08	3.700	0.50	1.00	2.70	0.70	5.84	1.00

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    4.3000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    4.3000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    4.3000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.2000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                   Block Case No.
From    -   To
    1   -     1                          1
    2   -     2                          2
    3   -     3                          5
    4   -     4                          1
    5   -     5                          3
    6   -     6                          5
    7   -     7                          1
    8   -     8                          3
    9   -     9                          5
   10   -    10                          1
   11   -    11                          3
   12   -    12                          5
   13   -    13                          1
   14   -    14                          4
   15   -    15                          5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :        S0          :        S1         :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :                    :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)     :    (t1) :  (t2)   :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:    0.70:     1.30:
   2: 1:         0.09 :    0.60:     1.40:    0.60:     1.40:
   3: 1:         0.01 :    0.54:     1.46:    0.54:     1.46:
 S  : M:  NUMBER      :        S3          :        S          :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :                    :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)     :    (t1) :  (t2)   :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:    0.00:     0.00:
   2: 1:         0.09 :    0.60:     1.40:    0.00:     0.00:
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

3:	1:	0.01 :	0.54:	1.46:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	9.57	0.70:	1.30:	-0.30:	0.30:
2:	1:	1.14	0.50:	1.50:	-0.50:	0.50:
3:	1:	0.57	0.40:	1.60:	-0.60:	0.60:
4:	1:	0.11	0.20:	1.80:	-0.80:	0.80:
5:	1:	0.02	0.00:	2.00:	-1.00:	1.00:
6:	1:	0.01	-0.20:	2.20:	-1.20:	1.20:
7:	1:	0.00	-0.40:	2.40:	-1.40:	1.40:
8:	1:	0.00	-0.60:	2.60:	-1.60:	1.60:
9:	1:	0.00	-0.80:	2.80:	-1.80:	1.80:
10:	1:	0.00	-1.00:	3.00:	-2.00:	2.00:

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	9.57	-0.30:	0.30:	0.00:	0.00:
2:	1:	1.14	-0.50:	0.50:	0.00:	0.00:
3:	1:	0.57	-0.60:	0.60:	0.00:	0.00:
4:	1:	0.11	-0.80:	0.80:	0.00:	0.00:
5:	1:	0.02	-1.00:	1.00:	0.00:	0.00:
6:	1:	0.01	-1.20:	1.20:	0.00:	0.00:
7:	1:	0.00	-1.40:	1.40:	0.00:	0.00:
8:	1:	0.00	-1.60:	1.60:	0.00:	0.00:
9:	1:	0.00	-1.80:	1.80:	0.00:	0.00:
10:	1:	0.00	-2.00:	2.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	19.14	0.70:	1.30:	-0.30:	0.30:
2:	1:	2.29	0.50:	1.50:	-0.50:	0.50:
3:	1:	1.14	0.40:	1.60:	-0.60:	0.60:
4:	1:	0.23	0.20:	1.80:	-0.80:	0.80:
5:	1:	0.04	0.00:	2.00:	-1.00:	1.00:
6:	1:	0.01	-0.20:	2.20:	-1.20:	1.20:
7:	1:	0.00	-0.40:	2.40:	-1.40:	1.40:
8:	1:	0.00	-0.60:	2.60:	-1.60:	1.60:
9:	1:	0.00	-0.80:	2.80:	-1.80:	1.80:
10:	1:	0.00	-1.00:	3.00:	-2.00:	2.00:

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	19.14	-0.30:	0.30:	0.00:	0.00:
2:	1:	2.29	-0.50:	0.50:	0.00:	0.00:
3:	1:	1.14	-0.60:	0.60:	0.00:	0.00:
4:	1:	0.23	-0.80:	0.80:	0.00:	0.00:

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

5	1	0.04	-1.00	1.00	0.00	0.00
6	1	0.01	-1.20	1.20	0.00	0.00
7	1	0.00	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.70	1.30	-0.30	0.30
2	1	4.57	0.50	1.50	-0.50	0.50
3	1	2.29	0.40	1.60	-0.60	0.60
4	1	0.46	0.20	1.80	-0.80	0.80
5	1	0.08	0.00	2.00	-1.00	1.00
6	1	0.02	-0.20	2.20	-1.20	1.20
7	1	0.01	-0.40	2.40	-1.40	1.40
8	1	0.00	-0.60	2.60	-1.60	1.60
9	1	0.00	-0.80	2.80	-1.80	1.80
10	1	0.00	-1.00	3.00	-2.00	2.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	38.29	-0.30	0.30	0.00	0.00
2	1	4.57	-0.50	0.50	0.00	0.00
3	1	2.29	-0.60	0.60	0.00	0.00
4	1	0.46	-0.80	0.80	0.00	0.00
5	1	0.08	-1.00	1.00	0.00	0.00
6	1	0.02	-1.20	1.20	0.00	0.00
7	1	0.01	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00

4:	1:	0.06 :	0.43:	1.18:	0.00:	0.00:
5:	1:	0.00 :	0.23:	1.24:	0.00:	0.00:
6:	1:	0.00 :	0.04:	1.30:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	1.90 :	-0.70:	-1.30:	0.00:	0.00:
2:	1:	0.09 :	-0.60:	-1.40:	0.00:	0.00:
3:	1:	0.01 :	-0.54:	-1.46:	0.00:	0.00:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	1.90 :	-0.70:	-1.30:	0.00:	0.00:
2:	1:	0.09 :	-0.60:	-1.40:	0.00:	0.00:
3:	1:	0.01 :	-0.54:	-1.46:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	9.57 :	3.01:	5.59:	0.00:	0.00:
2:	1:	1.14 :	2.15:	6.45:	0.00:	0.00:
3:	1:	0.57 :	1.72:	6.88:	0.00:	0.00:
4:	1:	0.11 :	0.86:	7.74:	0.00:	0.00:
5:	1:	0.02 :	0.00:	8.60:	0.00:	0.00:
6:	1:	0.01 :	-0.86:	9.46:	0.00:	0.00:
7:	1:	0.00 :	-1.72:	10.32:	0.00:	0.00:
8:	1:	0.00 :	-2.58:	11.18:	0.00:	0.00:
9:	1:	0.00 :	-3.44:	12.04:	0.00:	0.00:
10:	1:	0.00 :	-4.30:	12.90:	0.00:	0.00:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	9.57 :	0.00:	0.00:	0.00:	0.00:
2:	1:	1.14 :	0.00:	0.00:	0.00:	0.00:
3:	1:	0.57 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.11 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.02 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:
7:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
8:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	3.01	5.59	0.00	0.00
2	1	2.29	2.15	6.45	0.00	0.00
3	1	1.14	1.72	6.88	0.00	0.00
4	1	0.23	0.86	7.74	0.00	0.00
5	1	0.04	0.00	8.60	0.00	0.00
6	1	0.01	-0.86	9.46	0.00	0.00
7	1	0.00	-1.72	10.32	0.00	0.00
8	1	0.00	-2.58	11.18	0.00	0.00
9	1	0.00	-3.44	12.04	0.00	0.00
10	1	0.00	-4.30	12.90	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00
2	1	2.29	0.00	0.00	0.00	0.00
3	1	1.14	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.04	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	3.01	5.59	0.00	0.00
2	1	4.57	2.15	6.45	0.00	0.00
3	1	2.29	1.72	6.88	0.00	0.00
4	1	0.46	0.86	7.74	0.00	0.00
5	1	0.08	0.00	8.60	0.00	0.00
6	1	0.02	-0.86	9.46	0.00	0.00
7	1	0.01	-1.72	10.32	0.00	0.00
8	1	0.00	-2.58	11.18	0.00	0.00
9	1	0.00	-3.44	12.04	0.00	0.00
10	1	0.00	-4.30	12.90	0.00	0.00

```
S   : M:  NUMBER      :        S3          :         S          :
T   : A:    OF        :                    :                    :
E   : T:  FATIGUE     :       (ksi)        :       (ksi)        :
P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        38.29 :    0.00:     0.00:     0.00:     0.00:
   2: 1:         4.57 :    0.00:     0.00:     0.00:     0.00:
   3: 1:         2.29 :    0.00:     0.00:     0.00:     0.00:
   4: 1:         0.46 :    0.00:     0.00:     0.00:     0.00:
   5: 1:         0.08 :    0.00:     0.00:     0.00:     0.00:
   6: 1:         0.02 :    0.00:     0.00:     0.00:     0.00:
   7: 1:         0.01 :    0.00:     0.00:     0.00:     0.00:
   8: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:
   9: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:
  10: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER      :        S0          :        S1          :
T   : A:    OF        :                    :                    :
E   : T:  FATIGUE     :       (ksi)        :       (ksi)        :
P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.28 :    3.20:     3.23:     0.00:     0.00:
   2: 1:         0.44 :    2.59:     3.39:     0.00:     0.00:
   3: 1:         0.22 :    1.98:     3.58:     0.00:     0.00:
   4: 1:         0.06 :    1.38:     3.78:     0.00:     0.00:
   5: 1:         0.00 :    0.74:     3.97:     0.00:     0.00:
   6: 1:         0.00 :    0.13:     4.16:     0.00:     0.00:
S   : M:  NUMBER      :        S3          :         S          :
T   : A:    OF        :                    :                    :
E   : T:  FATIGUE     :       (ksi)        :       (ksi)        :
P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.28 :    0.00:     0.00:     0.00:     0.00:
   2: 1:         0.44 :    0.00:     0.00:     0.00:     0.00:
   3: 1:         0.22 :    0.00:     0.00:     0.00:     0.00:
   4: 1:         0.06 :    0.00:     0.00:     0.00:     0.00:
   5: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:
   6: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W1
MODEL: CC02

ANALYSIS RESULTS:
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Schdl	Block Step	Final Flaw Size a	c	K max a-tip	c-tip
200	15	0.050254	0.050035	2.514672	1.957333
400	15	0.050509	0.050070	2.515637	1.962630
600	15	0.050765	0.050107	2.516598	1.967908
800	15	0.051021	0.050144	2.517553	1.973170
1000	15	0.051278	0.050182	2.518503	1.978414

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

1200	15	0.051536	0.050221	2.519449	1.983640
1400	15	0.051794	0.050260	2.520390	1.988850
1600	15	0.052053	0.050301	2.521327	1.994042
1800	15	0.052313	0.050342	2.522260	1.999217
2000	15	0.052573	0.050384	2.523189	2.004374
2200	15	0.052834	0.050427	2.524114	2.009515
2400	15	0.053095	0.050471	2.525035	2.014638
2600	15	0.053358	0.050515	2.525954	2.019744
2800	15	0.053620	0.050560	2.526869	2.024833
3000	15	0.053884	0.050607	2.527781	2.029906
3200	15	0.054148	0.050653	2.528690	2.034961
3400	15	0.054413	0.050701	2.529596	2.040000
3600	15	0.054678	0.050750	2.530502	2.045021
3800	15	0.054944	0.050802	2.531440	2.050001
4000	15	0.055210	0.050856	2.532398	2.054950
4200	15	0.055478	0.050912	2.533372	2.059873
4400	15	0.055746	0.050970	2.534358	2.064771
4600	15	0.056014	0.051030	2.535354	2.069647
4800	15	0.056284	0.051091	2.536361	2.074501
5000	15	0.056554	0.051154	2.537378	2.079334
5200	15	0.056824	0.051218	2.538403	2.084148
5400	15	0.057096	0.051284	2.539438	2.088942
5600	15	0.057368	0.051351	2.540481	2.093717
5800	15	0.057641	0.051420	2.541534	2.098474
6000	15	0.057914	0.051490	2.542594	2.103214
6200	15	0.058189	0.051561	2.543664	2.107936
6400	15	0.058464	0.051634	2.544742	2.112641
6600	15	0.058739	0.051708	2.545828	2.117330
6800	15	0.059016	0.051784	2.546923	2.122003
7000	15	0.059293	0.051861	2.548027	2.126660
7200	15	0.059571	0.051939	2.549139	2.131302
7400	15	0.059850	0.052018	2.550260	2.135929
7600	15	0.060130	0.052099	2.551390	2.140542
7800	15	0.060410	0.052182	2.552528	2.145140
8000	15	0.060691	0.052265	2.553676	2.149725
8200	15	0.060973	0.052350	2.554833	2.154296
8400	15	0.061256	0.052437	2.555998	2.158854
8600	15	0.061540	0.052524	2.557173	2.163399
8800	15	0.061824	0.052613	2.558357	2.167932
9000	15	0.062109	0.052704	2.559551	2.172453
9200	15	0.062395	0.052795	2.560754	2.176962
9400	15	0.062682	0.052888	2.561966	2.181460
9600	15	0.062970	0.052982	2.563188	2.185946
9800	15	0.063259	0.053078	2.564420	2.190422
10000	15	0.063548	0.053175	2.565661	2.194887

MODEL: CC02

ANALYSIS RESULTS (contd.)

Schdl	Block Step	Final Flaw Size a	c	K max a-tip	c-tip
10200	15	0.063839	0.053274	2.566912	2.199342
10400	15	0.064130	0.053373	2.568174	2.203788
10600	15	0.064422	0.053474	2.569445	2.208224
10800	15	0.064715	0.053577	2.570726	2.212651
11000	15	0.065009	0.053681	2.572017	2.217069
11200	15	0.065303	0.053786	2.573319	2.221478
11400	15	0.065599	0.053892	2.574631	2.225880
11600	15	0.065896	0.054000	2.575954	2.230273
11800	15	0.066193	0.054109	2.577287	2.234659
12000	15	0.066492	0.054220	2.578630	2.239038
12200	15	0.066791	0.054332	2.579984	2.243410
12400	15	0.067091	0.054445	2.581349	2.247776
12600	15	0.067393	0.054560	2.582725	2.252135

12800	15	0.067695	0.054676	2.584111	2.256489
13000	15	0.067998	0.054794	2.585509	2.260837
13200	15	0.068303	0.054913	2.586917	2.265179
13400	15	0.068608	0.055033	2.588337	2.269517
13600	15	0.068914	0.055155	2.589767	2.273851
13800	15	0.069222	0.055278	2.591209	2.278180
14000	15	0.069530	0.055403	2.592662	2.282505
14200	15	0.069839	0.055529	2.594126	2.286827
14400	15	0.070150	0.055656	2.595602	2.291145
14600	15	0.070461	0.055785	2.597089	2.295461
14800	15	0.070774	0.055916	2.598588	2.299774
15000	15	0.071087	0.056048	2.600098	2.304084
15200	15	0.071402	0.056181	2.601619	2.308393
15400	15	0.071718	0.056316	2.603153	2.312701
15600	15	0.072035	0.056452	2.604698	2.317007
15800	15	0.072353	0.056590	2.606254	2.321312
16000	15	0.072672	0.056729	2.607823	2.325616
16200	15	0.072992	0.056870	2.609403	2.329921
16400	15	0.073314	0.057012	2.610995	2.334225
16600	15	0.073636	0.057156	2.612599	2.338530
16800	15	0.073960	0.057302	2.614215	2.342836
17000	15	0.074285	0.057449	2.615843	2.347143
17200	15	0.074611	0.057597	2.617483	2.351452
17400	15	0.074938	0.057747	2.619135	2.355762
17600	15	0.075267	0.057899	2.620800	2.360074
17800	15	0.075596	0.058052	2.622476	2.364389
18000	15	0.075927	0.058207	2.624165	2.368707
18200	15	0.076259	0.058363	2.625866	2.373028
18400	15	0.076593	0.058521	2.627579	2.377353
18600	15	0.076928	0.058680	2.629304	2.381681
18800	15	0.077264	0.058842	2.631042	2.386014
19000	15	0.077601	0.059004	2.632792	2.390351
19200	15	0.077939	0.059169	2.634555	2.394694
19400	15	0.078279	0.059335	2.636330	2.399042
19600	15	0.078621	0.059503	2.638117	2.403395
19800	15	0.078963	0.059672	2.639918	2.407755
20000	15	0.079307	0.059844	2.641730	2.412121

MODEL: CC02

ANALYSIS RESULTS (contd.)

Schdl	Block Step	Final Flaw Size a	c	K max a-tip	c-tip
20200	15	0.079652	0.060017	2.643555	2.416493
20400	15	0.079999	0.060191	2.645393	2.420873
20600	15	0.080347	0.060367	2.647244	2.425261
20800	15	0.080696	0.060546	2.649107	2.429656
21000	15	0.081047	0.060725	2.650983	2.434060
21200	15	0.081399	0.060907	2.652871	2.438472
21400	15	0.081753	0.061090	2.654772	2.442893
21600	15	0.082108	0.061277	2.656705	2.447317
21800	15	0.082465	0.061471	2.658731	2.451722
22000	15	0.082823	0.061670	2.660815	2.456123
22200	15	0.083182	0.061874	2.662946	2.460525
22400	15	0.083544	0.062082	2.665118	2.464931
22600	15	0.083907	0.062293	2.667327	2.469344
22800	15	0.084272	0.062508	2.669572	2.473766
23000	15	0.084638	0.062727	2.671850	2.478197
23200	15	0.085007	0.062949	2.674160	2.482639
23400	15	0.085377	0.063174	2.676502	2.487094
23600	15	0.085749	0.063403	2.678873	2.491562
23800	15	0.086122	0.063635	2.681273	2.496045
24000	15	0.086498	0.063870	2.683702	2.500544
24200	15	0.086876	0.064109	2.686159	2.505059

24400	15	0.087255	0.064351	2.688642	2.509591
24600	15	0.087637	0.064596	2.691153	2.514143
24800	15	0.088020	0.064845	2.693691	2.518713
25000	15	0.088406	0.065097	2.696254	2.523304
25200	15	0.088793	0.065352	2.698843	2.527916
25400	15	0.089183	0.065610	2.701457	2.532549
25600	15	0.089575	0.065872	2.704097	2.537206
25800	15	0.089969	0.066137	2.706761	2.541886
26000	15	0.090365	0.066406	2.709451	2.546591
26200	15	0.090763	0.066678	2.712164	2.551321
26400	15	0.091163	0.066953	2.714902	2.556077
26600	15	0.091566	0.067232	2.717664	2.560861
26800	15	0.091971	0.067514	2.720450	2.565672
27000	15	0.092378	0.067800	2.723259	2.570511
27200	15	0.092788	0.068089	2.726093	2.575381
27400	15	0.093199	0.068382	2.728949	2.580280
27600	15	0.093614	0.068678	2.731830	2.585211
27800	15	0.094030	0.068978	2.734733	2.590173
28000	15	0.094449	0.069282	2.737660	2.595169
28200	15	0.094871	0.069590	2.740610	2.600198
28400	15	0.095295	0.069901	2.743582	2.605262
28600	15	0.095721	0.070216	2.746578	2.610361
28800	15	0.096150	0.070534	2.749597	2.615497
29000	15	0.096581	0.070857	2.752638	2.620670
29200	15	0.097016	0.071183	2.755703	2.625881
29400	15	0.097452	0.071514	2.758790	2.631130
29600	15	0.097892	0.071848	2.761899	2.636420
29800	15	0.098334	0.072187	2.765032	2.641751
30000	15	0.098778	0.072529	2.768187	2.647123

MODEL: CC02

ANALYSIS RESULTS (contd.)

Schdl	Block Step	Final Flaw Size a	c	K max a-tip	c-tip
30200	15	0.099226	0.072876	2.771364	2.652538
30400	15	0.099676	0.073227	2.774564	2.657997
30600	15	0.100129	0.073582	2.777787	2.663500
30800	15	0.100585	0.073942	2.781032	2.669049
31000	15	0.101044	0.074306	2.784300	2.674644
31200	15	0.101505	0.074674	2.787590	2.680287
31400	15	0.101970	0.075047	2.790903	2.685978
31600	15	0.102437	0.075425	2.794238	2.691720
31800	15	0.102908	0.075807	2.797596	2.697511
32000	15	0.103381	0.076194	2.800976	2.703355
32200	15	0.103857	0.076586	2.804378	2.709251
32400	15	0.104337	0.076982	2.807803	2.715201
32600	15	0.104820	0.077384	2.811250	2.721207
32800	15	0.105305	0.077790	2.814720	2.727268
33000	15	0.105794	0.078202	2.818212	2.733386
33200	15	0.106286	0.078619	2.821726	2.739563
33400	15	0.106782	0.079041	2.825263	2.745800
33600	15	0.107280	0.079468	2.828822	2.752097
33800	15	0.107782	0.079901	2.832403	2.758456
34000	15	0.108287	0.080340	2.836007	2.764878
34200	15	0.108796	0.080784	2.839633	2.771365
34400	15	0.109308	0.081234	2.843281	2.777918
34600	15	0.109823	0.081689	2.846951	2.784537
34800	15	0.110342	0.082151	2.850644	2.791225
35000	15	0.110865	0.082618	2.854358	2.797982
35200	15	0.111391	0.083092	2.858095	2.804810
35400	15	0.111920	0.083572	2.861853	2.811711
35600	15	0.112453	0.084059	2.865634	2.818685
35800	15	0.112990	0.084552	2.869436	2.825734

36000	15	0.113531	0.085051	2.873259	2.832859
36200	15	0.114075	0.085558	2.877105	2.840063
36400	15	0.114623	0.086071	2.880971	2.847346
36600	15	0.115175	0.086591	2.884859	2.854709
36800	15	0.115730	0.087118	2.888768	2.862155
37000	15	0.116290	0.087653	2.892698	2.869684
37200	15	0.116853	0.088195	2.896649	2.877299
37400	15	0.117421	0.088744	2.900620	2.885001
37600	15	0.117992	0.089302	2.904611	2.892791
37800	15	0.118568	0.089867	2.908622	2.900671
38000	15	0.119147	0.090440	2.912653	2.908642
38200	15	0.119731	0.091022	2.916703	2.916707
38400	15	0.120318	0.091612	2.920772	2.924866
38600	15	0.120910	0.092210	2.924860	2.933122
38800	15	0.121506	0.092817	2.928965	2.941475
39000	15	0.122107	0.093433	2.933089	2.949928
39200	15	0.122711	0.094058	2.937229	2.958483
39400	15	0.123320	0.094693	2.941386	2.967139
39600	15	0.123934	0.095337	2.945558	2.975901
39800	15	0.124552	0.095991	2.949746	2.984768

```
Transition to 1-d solution, TC03:
a =    0.1250       t =    0.1250
at Cycle No.         19.14  of Load Step No.    1
Step description:
of Block No.       8  of Schedule No.   39945
Crack Size:  c =  0.964688E-01 ,  a/c =     1.29576
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
40000	15		0.096842	3.250017
40200	15		0.098203	3.265866
40400	15		0.099594	3.282332
40600	15		0.101017	3.299460
40800	15		0.102475	3.317303
41000	15		0.103969	3.335916

```
FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No.           0.00  of Load Step No.    6
Step description:
of Block No.      15  of Schedule No.   41000
Crack Size      c =  0.103969


                 FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
               DATE: 25-MAR-99   TIME: 09:36:14
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 11, PSE-W1 SA226 MS, crack in cap WS112 (

GEOMETRY
--------
MODEL: TC11-Corner crack in plate or bar (2D)

Plate Thickness, t =     0.1250
  "   Width, W      =    3.0000
Hole Diameter, D    =    0.1600
Hole-Center-to-Edge Dist., B =     0.3100
2ND AREA, AREATC11 =     0.7350
2ND M. INERTIA =     0.2580
2ND C.G. =      1.4520
```

FLAW SIZE:

c (init.) = 0.9650E-01

MATERIAL

MATL 1:
1 2014T6511 EXTRUSION T-L

Material Properties:

:Matl: No.:	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	74.0	65.0	27.0	27.0	1.00	1.00	0.125	51.8	

:Matl:---------- Crack Growth Eqn Constants -------------:

:Matl: No.:	C	n	p	q	DKo	Rcl	Alpha	Smax/SIGo
1	0.200D-08	3.700	0.50	1.00	2.70	0.70	5.84	1.00

MODEL: TC11

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0: -1.0000
Scale Factor for Stress S3: -1.0000

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 4.3000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 4.3000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 4.3000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 3.2000
Scale Factor for Stress S3: 0.0000

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	- To	Block Case No.
1	1	1

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	9.57	0.70	1.30	-0.30	0.30
2	1	1.14	0.50	1.50	-0.50	0.50
3	1	0.57	0.40	1.60	-0.60	0.60
4	1	0.11	0.20	1.80	-0.80	0.80
5	1	0.02	0.00	2.00	-1.00	1.00
6	1	0.01	-0.20	2.20	-1.20	1.20
7	1	0.00	-0.40	2.40	-1.40	1.40
8	1	0.00	-0.60	2.60	-1.60	1.60
9	1	0.00	-0.80	2.80	-1.80	1.80
10	1	0.00	-1.00	3.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	0.70	1.30	-0.30	0.30
2	1	2.29	0.50	1.50	-0.50	0.50
3	1	1.14	0.40	1.60	-0.60	0.60
4	1	0.23	0.20	1.80	-0.80	0.80
5	1	0.04	0.00	2.00	-1.00	1.00
6	1	0.01	-0.20	2.20	-1.20	1.20
7	1	0.00	-0.40	2.40	-1.40	1.40
8	1	0.00	-0.60	2.60	-1.60	1.60
9	1	0.00	-0.80	2.80	-1.80	1.80
10	1	0.00	-1.00	3.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	0.70	1.30	-0.30	0.30
2	1	4.57	0.50	1.50	-0.50	0.50
3	1	2.29	0.40	1.60	-0.60	0.60
4	1	0.46	0.20	1.80	-0.80	0.80
5	1	0.08	0.00	2.00	-1.00	1.00
6	1	0.02	-0.20	2.20	-1.20	1.20
7	1	0.01	-0.40	2.40	-1.40	1.40
8	1	0.00	-0.60	2.60	-1.60	1.60
9	1	0.00	-0.80	2.80	-1.80	1.80
10	1	0.00	-1.00	3.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	-0.70	-1.30	-0.70	-1.30
2	1	0.09	-0.60	-1.40	-0.60	-1.40
3	1	0.01	-0.54	-1.46	-0.54	-1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF	S0	S3

E P	T: L:	FATIGUE CYCLES	(ksi) (t1)	(t2)	(ksi) (t1)	(t2)
1:	1:	9.57	3.01:	5.59:	0.00:	0.00:
2:	1:	1.14	2.15:	6.45:	0.00:	0.00:
3:	1:	0.57	1.72:	6.88:	0.00:	0.00:
4:	1:	0.11	0.86:	7.74:	0.00:	0.00:
5:	1:	0.02	0.00:	8.60:	0.00:	0.00:
6:	1:	0.01	-0.86:	9.46:	0.00:	0.00:
7:	1:	0.00	-1.72:	10.32:	0.00:	0.00:
8:	1:	0.00	-2.58:	11.18:	0.00:	0.00:
9:	1:	0.00	-3.44:	12.04:	0.00:	0.00:
10:	1:	0.00	-4.30:	12.90:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	19.14	3.01:	5.59:	0.00:	0.00:
2:	1:	2.29	2.15:	6.45:	0.00:	0.00:
3:	1:	1.14	1.72:	6.88:	0.00:	0.00:
4:	1:	0.23	0.86:	7.74:	0.00:	0.00:
5:	1:	0.04	0.00:	8.60:	0.00:	0.00:
6:	1:	0.01	-0.86:	9.46:	0.00:	0.00:
7:	1:	0.00	-1.72:	10.32:	0.00:	0.00:
8:	1:	0.00	-2.58:	11.18:	0.00:	0.00:
9:	1:	0.00	-3.44:	12.04:	0.00:	0.00:
10:	1:	0.00	-4.30:	12.90:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	38.29	3.01:	5.59:	0.00:	0.00:
2:	1:	4.57	2.15:	6.45:	0.00:	0.00:
3:	1:	2.29	1.72:	6.88:	0.00:	0.00:
4:	1:	0.46	0.86:	7.74:	0.00:	0.00:
5:	1:	0.08	0.00:	8.60:	0.00:	0.00:
6:	1:	0.02	-0.86:	9.46:	0.00:	0.00:
7:	1:	0.01	-1.72:	10.32:	0.00:	0.00:
8:	1:	0.00	-2.58:	11.18:	0.00:	0.00:
9:	1:	0.00	-3.44:	12.04:	0.00:	0.00:
10:	1:	0.00	-4.30:	12.90:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	3.20	3.23	0.00	0.00
2	1	0.44	2.59	3.39	0.00	0.00
3	1	0.22	1.98	3.58	0.00	0.00
4	1	0.06	1.38	3.78	0.00	0.00
5	1	0.00	0.74	3.97	0.00	0.00
6	1	0.00	0.13	4.16	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.097723	3.189143
400	15		0.098969	3.202559
600	15		0.100240	3.216442
800	15		0.101536	3.230825
1000	15		0.102858	3.245742
1200	15		0.104209	3.261229
1400	15		0.105590	3.277328
1600	15		0.107002	3.294085
1800	15		0.108448	3.311550
2000	15		0.109929	3.329782
2200	15		0.111447	3.348844
2400	15		0.113006	3.368807
2600	15		0.114608	3.389754
2800	15		0.116255	3.411776
3000	15		0.117952	3.434978
3200	15		0.119701	3.459484
3400	15		0.121509	3.485432
3600	15		0.123378	3.512989
3800	15		0.125316	3.542345
4000	15		0.127328	3.573730
4200	15		0.129423	3.607419
4400	15		0.131608	3.643741
4600	15		0.133895	3.683104
4800	15		0.136296	3.726012
5000	15		0.138827	3.773105
5200	15		0.141507	3.825201
5400	15		0.144359	3.883377
5600	15		0.147414	3.949089
5800	15		0.150713	4.024360
6000	15		0.154311	4.112126
6200	15		0.158287	4.216853
6400	15		0.162758	4.345807
6600	15		0.167917	4.511936
6800	15		0.174110	4.741688
7000	15		0.182102	5.103000
7200	15		0.194394	5.885335

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     53.62     K ref =     0.000      K cr =    51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.     14  of Schedule No.    7337
Crack Size     c =  0.225983


                 FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
               DATE: 07-OCT-98    TIME: 12:39:28
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC2, PSE-W1 SA226 Main Spar Cap WS99       (Title)

GEOMETRY
--------
MODEL: TC02-Single edge through crack.

Plate Thickness, t =    0.1250
  "   Width, W     =    3.0000

FLAW SIZE:

c   (init.) =  0.5000E-01




MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

```
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    5.3700
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    5.3700
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    5.3700
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    4.0500
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
    1   -      1                        1
    2   -      2                        2
    3   -      3                        5
    4   -      4                        1
    5   -      5                        3
    6   -      6                        5
    7   -      7                        1
    8   -      8                        3
    9   -      9                        5
   10   -     10                        1
   11   -     11                        3
   12   -     12                        5
   13   -     13                        1
   14   -     14                        4
   15   -     15                        5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :        S0          :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:    -0.30:      0.30:
   2: 1:         0.09 :    0.60:     1.40:    -0.40:      0.40:
   3: 1:         0.01 :    0.54:     1.46:    -0.46:      0.46:
 S  : M:  NUMBER      :        S2          :        S           :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :   -0.30:     0.30:     0.00:      0.00:
   2: 1:         0.09 :   -0.40:     0.40:     0.00:      0.00:
   3: 1:         0.01 :   -0.46:     0.46:     0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
```

BLOCK CASE NO. 2

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	9.57	0.60	1.20	-0.30	0.30
2	1	1.14	0.40	1.40	-0.50	0.50
3	1	0.57	0.30	1.50	-0.60	0.60
4	1	0.11	0.10	1.70	-0.80	0.80
5	1	0.02	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	9.57	-0.30	0.30	0.00	0.00
2	1	1.14	-0.50	0.50	0.00	0.00
3	1	0.57	-0.60	0.60	0.00	0.00
4	1	0.11	-0.80	0.80	0.00	0.00
5	1	0.02	-1.00	1.00	0.00	0.00
6	1	0.01	-1.20	1.20	0.00	0.00
7	1	0.00	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.60	1.20	-0.30	0.30
2	1	2.29	0.40	1.40	-0.50	0.50
3	1	1.14	0.30	1.50	-0.60	0.60
4	1	0.23	0.10	1.70	-0.80	0.80
5	1	0.04	-0.10	1.90	-1.00	1.00
6	1	0.01	-0.30	2.10	-1.20	1.20
7	1	0.00	-0.50	2.30	-1.40	1.40
8	1	0.00	-0.70	2.50	-1.60	1.60
9	1	0.00	-0.90	2.70	-1.80	1.80
10	1	0.00	-1.10	2.90	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	19.14	-0.30	0.30	0.00	0.00
2	1	2.29	-0.50	0.50	0.00	0.00
3	1	1.14	-0.60	0.60	0.00	0.00
4	1	0.23	-0.80	0.80	0.00	0.00
5	1	0.04	-1.00	1.00	0.00	0.00
6	1	0.01	-1.20	1.20	0.00	0.00
7	1	0.00	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00

```
   9: 1:        0.00 :   -1.80:     1.80:     0.00:     0.00:
  10: 1:        0.00 :   -2.00:     2.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                         -------

BLOCK CASE NO.  4
 S  : M:  NUMBER      :        S0          :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:       38.29 :    0.60:     1.20:    -0.30:     0.30:
   2: 1:        4.57 :    0.40:     1.40:    -0.50:     0.50:
   3: 1:        2.29 :    0.30:     1.50:    -0.60:     0.60:
   4: 1:        0.46 :    0.10:     1.70:    -0.80:     0.80:
   5: 1:        0.08 :   -0.10:     1.90:    -1.00:     1.00:
   6: 1:        0.02 :   -0.30:     2.10:    -1.20:     1.20:
   7: 1:        0.01 :   -0.50:     2.30:    -1.40:     1.40:
   8: 1:        0.00 :   -0.70:     2.50:    -1.60:     1.60:
   9: 1:        0.00 :   -0.90:     2.70:    -1.80:     1.80:
  10: 1:        0.00 :   -1.10:     2.90:    -2.00:     2.00:
 S  : M:  NUMBER      :        S2          :        S           :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:       38.29 :   -0.30:     0.30:     0.00:     0.00:
   2: 1:        4.57 :   -0.50:     0.50:     0.00:     0.00:
   3: 1:        2.29 :   -0.60:     0.60:     0.00:     0.00:
   4: 1:        0.46 :   -0.80:     0.80:     0.00:     0.00:
   5: 1:        0.08 :   -1.00:     1.00:     0.00:     0.00:
   6: 1:        0.02 :   -1.20:     1.20:     0.00:     0.00:
   7: 1:        0.01 :   -1.40:     1.40:     0.00:     0.00:
   8: 1:        0.00 :   -1.60:     1.60:     0.00:     0.00:
   9: 1:        0.00 :   -1.80:     1.80:     0.00:     0.00:
  10: 1:        0.00 :   -2.00:     2.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                         -------

BLOCK CASE NO.  5
 S  : M:  NUMBER      :        S0          :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        0.28 :    1.00:     1.01:     1.00:     1.01:
   2: 1:        0.44 :    0.81:     1.06:     0.81:     1.06:
   3: 1:        0.22 :    0.62:     1.12:     0.62:     1.12:
   4: 1:        0.06 :    0.43:     1.18:     0.42:     1.18:
   5: 1:        0.00 :    0.23:     1.24:     0.23:     1.24:
   6: 1:        0.00 :    0.04:     1.30:     0.04:     1.30:
 S  : M:  NUMBER      :        S2          :        S           :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        0.28 :    1.00:     1.00:     0.00:     0.00:
   2: 1:        0.44 :    0.81:     1.06:     0.00:     0.00:
   3: 1:        0.22 :    0.62:     1.12:     0.00:     0.00:
   4: 1:        0.06 :    0.43:     1.18:     0.00:     0.00:
   5: 1:        0.00 :    0.23:     1.24:     0.00:     0.00:
   6: 1:        0.00 :    0.04:     1.30:     0.00:     0.00:
```

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	1.90	-0.70	-1.30	0.00	0.00
2:	1:	0.09	-0.60	-1.40	0.00	0.00
3:	1:	0.01	-0.54	-1.46	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	1.90	0.00	0.00	0.00	0.00
2:	1:	0.09	0.00	0.00	0.00	0.00
3:	1:	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	9.57	3.22	6.44	0.00	0.00
2:	1:	1.14	2.15	7.52	0.00	0.00
3:	1:	0.57	1.61	8.05	0.00	0.00
4:	1:	0.11	0.54	9.13	0.00	0.00
5:	1:	0.02	-0.54	10.20	0.00	0.00
6:	1:	0.01	-1.61	11.28	0.00	0.00
7:	1:	0.00	-2.68	12.35	0.00	0.00
8:	1:	0.00	-3.76	13.43	0.00	0.00
9:	1:	0.00	-4.83	14.50	0.00	0.00
10:	1:	0.00	-5.91	15.57	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	9.57	0.00	0.00	0.00	0.00
2:	1:	1.14	0.00	0.00	0.00	0.00
3:	1:	0.57	0.00	0.00	0.00	0.00
4:	1:	0.11	0.00	0.00	0.00	0.00
5:	1:	0.02	0.00	0.00	0.00	0.00
6:	1:	0.01	0.00	0.00	0.00	0.00
7:	1:	0.00	0.00	0.00	0.00	0.00
8:	1:	0.00	0.00	0.00	0.00	0.00
9:	1:	0.00	0.00	0.00	0.00	0.00
10:	1:	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	3.22	6.44	0.00	0.00
2	1	2.29	2.15	7.52	0.00	0.00
3	1	1.14	1.61	8.05	0.00	0.00
4	1	0.23	0.54	9.13	0.00	0.00
5	1	0.04	-0.54	10.20	0.00	0.00
6	1	0.01	-1.61	11.28	0.00	0.00
7	1	0.00	-2.68	12.35	0.00	0.00
8	1	0.00	-3.76	13.43	0.00	0.00
9	1	0.00	-4.83	14.50	0.00	0.00
10	1	0.00	-5.91	15.57	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00
2	1	2.29	0.00	0.00	0.00	0.00
3	1	1.14	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.04	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	3.22	6.44	0.00	0.00
2	1	4.57	2.15	7.52	0.00	0.00
3	1	2.29	1.61	8.05	0.00	0.00
4	1	0.46	0.54	9.13	0.00	0.00
5	1	0.08	-0.54	10.20	0.00	0.00
6	1	0.02	-1.61	11.28	0.00	0.00
7	1	0.01	-2.68	12.35	0.00	0.00
8	1	0.00	-3.76	13.43	0.00	0.00
9	1	0.00	-4.83	14.50	0.00	0.00
10	1	0.00	-5.91	15.57	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)

1:	1:	38.29 :	0.00:	0.00:	0.00:	0.00:
2:	1:	4.57 :	0.00:	0.00:	0.00:	0.00:
3:	1:	2.29 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.46 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.08 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.02 :	0.00:	0.00:	0.00:	0.00:
7:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:
8:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
9:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
10:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP :	MAT :	NUMBER OF FATIGUE CYCLES :	S0 (ksi) (t1) :	S0 (ksi) (t2) :	S1 (ksi) (t1) :	S1 (ksi) (t2) :
1:	1:	0.28 :	4.05:	4.09:	0.00:	0.00:
2:	1:	0.44 :	3.28:	4.29:	0.00:	0.00:
3:	1:	0.22 :	2.51:	4.54:	0.00:	0.00:
4:	1:	0.06 :	1.74:	4.78:	0.00:	0.00:
5:	1:	0.00 :	0.93:	5.02:	0.00:	0.00:
6:	1:	0.00 :	0.16:	5.26:	0.00:	0.00:

STEP :	MAT :	NUMBER OF FATIGUE CYCLES :	S2 (ksi) (t1) :	S2 (ksi) (t2) :	S (ksi) (t1) :	S (ksi) (t2) :
1:	1:	0.28 :	0.00:	0.00:	0.00:	0.00:
2:	1:	0.44 :	0.00:	0.00:	0.00:	0.00:
3:	1:	0.22 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.06 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-W1 SA226 Main Spar
MODEL: TC02

ANALYSIS RESULTS:

Schedl	Block Step	Final Flaw Size c	K max c-tip
2000	15	0.052070	2.402388
4000	15	0.054381	2.455871
6000	15	0.056977	2.514669
8000	15	0.060151	2.584848
10000	15	0.064067	2.669108
12000	15	0.068862	2.769069
14000	15	0.074799	2.888474
16000	15	0.082289	3.033097
18000	15	0.091992	3.211901
20000	15	0.105030	3.439549

C-1 PSE W1 SA226 Main Spar Lower Cap at WS 99 (Continued)

22000	15	0.123485	3.742127
24000	15	0.151762	4.172413
26000	15	0.201422	4.863504
28000	15	0.320735	6.364526

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     51.96     K ref =     0.000     K cr =     51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.      14  of Schedule No.   29380
Crack Size     c =   1.04187
```

C-2 PSE W2 SA226 Main Spar Lower Cap at WS 9.0

```
                    FATIGUE CRACK GROWTH ANALYSIS
                   -------Modified by FAI-------
                  DATE: 26-MAR-99   TIME: 08:28:56
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W2 SA226 MS, crack in cap WS 9

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    3.5500
Hole Diameter, D   =    0.2000
Hole-Center-to-Edge Dist., B =    0.6100
Poisson s ratio    =    0.30

FLAW SIZE:

a   (init.) =  0.5000E-01
c   (init.) =  0.5000E-01
a/c (init.) =   1.000



MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    7.5000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  2
```

Scale Factor for Stress S0: 7.5000
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 7.5000
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 7.5000
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 3.7600
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 0.0000

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.37	0.97	0.70	1.30
2	1	0.09	0.27	1.07	0.60	1.40
3	1	0.01	0.21	1.13	0.54	1.46

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	1.90	0.70	1.30	0.00	0.00
2	1	0.09	0.60	1.40	0.00	0.00
3	1	0.01	0.54	1.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF	S0	S1

E P	T: L:	FATIGUE CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	9.57	0.37	0.97	0.70	1.30
2	1	1.14	0.17	1.17	0.50	1.50
3	1	0.57	0.07	1.27	0.40	1.60
4	1	0.11	-0.13	1.47	0.20	1.80
5	1	0.02	-0.33	1.67	0.00	2.00
6	1	0.01	-0.53	1.87	-0.20	2.20
7	1	0.00	-0.73	2.07	-0.40	2.40
8	1	0.00	-0.93	2.27	-0.60	2.60
9	1	0.00	-1.13	2.47	-0.80	2.80
10	1	0.00	-1.33	2.67	-1.00	3.00

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	9.57	0.70	1.30	0.00	0.00
2	1	1.14	0.50	1.50	0.00	0.00
3	1	0.57	0.40	1.60	0.00	0.00
4	1	0.11	0.20	1.80	0.00	0.00
5	1	0.02	0.00	2.00	0.00	0.00
6	1	0.01	-0.20	2.20	0.00	0.00
7	1	0.00	-0.40	2.40	0.00	0.00
8	1	0.00	-0.60	2.60	0.00	0.00
9	1	0.00	-0.80	2.80	0.00	0.00
10	1	0.00	-1.00	3.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.37	0.97	0.70	1.30
2	1	2.29	0.17	1.17	0.50	1.50
3	1	1.14	0.07	1.27	0.40	1.60
4	1	0.23	-0.13	1.47	0.20	1.80
5	1	0.04	-0.33	1.67	0.00	2.00
6	1	0.01	-0.53	1.87	-0.20	2.20
7	1	0.00	-0.73	2.07	-0.40	2.40
8	1	0.00	-0.93	2.27	-0.60	2.60
9	1	0.00	-1.13	2.47	-0.80	2.80
10	1	0.00	-1.33	2.67	-1.00	3.00

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	19.14	0.70	1.30	0.00	0.00
2	1	2.29	0.50	1.50	0.00	0.00
3	1	1.14	0.40	1.60	0.00	0.00
4	1	0.23	0.20	1.80	0.00	0.00
5	1	0.04	0.00	2.00	0.00	0.00
6	1	0.01	-0.20	2.20	0.00	0.00
7	1	0.00	-0.40	2.40	0.00	0.00
8	1	0.00	-0.60	2.60	0.00	0.00
9	1	0.00	-0.80	2.80	0.00	0.00
10	1	0.00	-1.00	3.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.37	0.97	0.70	1.30
2	1	4.57	0.17	1.17	0.50	1.50
3	1	2.29	0.07	1.27	0.40	1.60
4	1	0.46	-0.13	1.47	0.20	1.80
5	1	0.08	-0.33	1.67	0.00	2.00
6	1	0.02	-0.53	1.87	-0.20	2.20
7	1	0.01	-0.73	2.07	-0.40	2.40
8	1	0.00	-0.93	2.27	-0.60	2.60
9	1	0.00	-1.13	2.47	-0.80	2.80
10	1	0.00	-1.33	2.67	-1.00	3.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	38.29	0.70	1.30	0.00	0.00
2	1	4.57	0.50	1.50	0.00	0.00
3	1	2.29	0.40	1.60	0.00	0.00
4	1	0.46	0.20	1.80	0.00	0.00
5	1	0.08	0.00	2.00	0.00	0.00
6	1	0.02	-0.20	2.20	0.00	0.00
7	1	0.01	-0.40	2.40	0.00	0.00
8	1	0.00	-0.60	2.60	0.00	0.00
9	1	0.00	-0.80	2.80	0.00	0.00
10	1	0.00	-1.00	3.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.12	0.81	1.12
3	1	0.22	0.61	1.23	0.61	1.23
4	1	0.06	0.42	1.33	0.42	1.33
5	1	0.00	0.22	2.44	0.22	2.44
6	1	0.00	0.03	2.55	0.03	2.55

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.01	0.00	0.00
2	1	0.44	0.81	1.12	0.00	0.00
3	1	0.22	0.61	1.23	0.00	0.00
4	1	0.06	0.42	1.33	0.00	0.00
5	1	0.00	0.22	2.44	0.00	0.00
6	1	0.00	0.03	2.55	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

C-2 PSE W2 SA226 Main Spar Lower Cap at WS 9.0 (Continued)

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	2.78	7.27	0.00	0.00
2	1	0.09	2.03	8.03	0.00	0.00
3	1	0.01	1.58	8.48	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	2.78	7.27	0.00	0.00
2	1	1.14	1.28	8.77	0.00	0.00
3	1	0.57	0.53	9.53	0.00	0.00
4	1	0.11	-0.98	11.03	0.00	0.00
5	1	0.02	-2.47	12.52	0.00	0.00
6	1	0.01	-3.97	14.03	0.00	0.00
7	1	0.00	-5.47	15.52	0.00	0.00
8	1	0.00	-6.98	17.02	0.00	0.00
9	1	0.00	-8.47	18.53	0.00	0.00
10	1	0.00	-9.98	20.02	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	0.00	0.00	0.00	0.00
2	1	1.14	0.00	0.00	0.00	0.00
3	1	0.57	0.00	0.00	0.00	0.00
4	1	0.11	0.00	0.00	0.00	0.00
5	1	0.02	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S : M:	NUMBER :	S0 :	S1 :
T : A:	OF :	:	:
E : T:	FATIGUE :	(ksi) :	(ksi) :

P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	19.14	2.78	7.27	0.00	0.00
2	1	2.29	1.28	8.77	0.00	0.00
3	1	1.14	0.53	9.53	0.00	0.00
4	1	0.23	-0.98	11.03	0.00	0.00
5	1	0.04	-2.47	12.52	0.00	0.00
6	1	0.01	-3.97	14.03	0.00	0.00
7	1	0.00	-5.47	15.52	0.00	0.00
8	1	0.00	-6.98	17.02	0.00	0.00
9	1	0.00	-8.47	18.53	0.00	0.00
10	1	0.00	-9.98	20.02	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00
2	1	2.29	0.00	0.00	0.00	0.00
3	1	1.14	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.04	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	2.78	7.27	0.00	0.00
2	1	4.57	1.28	8.77	0.00	0.00
3	1	2.29	0.53	9.53	0.00	0.00
4	1	0.46	-0.98	11.03	0.00	0.00
5	1	0.08	-2.47	12.52	0.00	0.00
6	1	0.02	-3.97	14.03	0.00	0.00
7	1	0.01	-5.47	15.52	0.00	0.00
8	1	0.00	-6.98	17.02	0.00	0.00
9	1	0.00	-8.47	18.53	0.00	0.00
10	1	0.00	-9.98	20.02	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	38.29	0.00	0.00	0.00	0.00
2	1	4.57	0.00	0.00	0.00	0.00
3	1	2.29	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.08	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses

C-2 PSE W2 SA226 Main Spar Lower Cap at WS 9.0 (Continued)

(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28	3.76	3.80	0.00	0.00
2:	1:	0.44	3.05	4.21	0.00	0.00
3:	1:	0.22	2.29	4.62	0.00	0.00
4:	1:	0.06	1.58	5.00	0.00	0.00
5:	1:	0.00	0.83	9.17	0.00	0.00
6:	1:	0.00	0.11	9.59	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	0.28	0.00	0.00	0.00	0.00
2:	1:	0.44	0.00	0.00	0.00	0.00
3:	1:	0.22	0.00	0.00	0.00	0.00
4:	1:	0.06	0.00	0.00	0.00	0.00
5:	1:	0.00	0.00	0.00	0.00	0.00
6:	1:	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block	Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15		0.054109	0.051488	6.272930	5.129302
400	15		0.058440	0.053266	6.348376	5.311132
600	15		0.063016	0.055361	6.428926	5.488763
800	15		0.067864	0.057801	6.515588	5.664665
1000	15		0.073019	0.060623	6.609100	5.841599
1200	15		0.078522	0.063874	6.710016	6.022634
1400	15		0.084420	0.067614	6.818773	6.211213
1600	15		0.090765	0.071923	6.935737	6.411288
1800	15		0.097618	0.076909	7.061186	6.627466
2000	15		0.105050	0.082718	7.195213	6.865209
2200	15		0.113136	0.089555	7.337417	7.130981
2400	15		0.121959	0.097703	7.486103	7.432104

Transition to 1-d solution, TC03:
a = 0.1250 t = 0.1250
at Cycle No. 9.57. of Load Step No. 1
Step description:
of Block No. 2 of Schedule No. 2466
Crack Size: c = 0.100699 , a/c = 1.24132

Schedl	Block	Step	Final Flaw Size c	K max c-tip
2600	15		0.108501	7.421609

2800	15	0.120830	7.563978
3000	15	0.134242	7.726167
3200	15	0.148987	7.913794
3400	15	0.165409	8.134862
3600	15	0.184016	8.401759
3800	15	0.205599	8.735486
4000	15	0.231511	9.176208
4200	15	0.264463	9.816461
4400	15	0.311665	10.960449
4600	15	0.429566	17.165632

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =    52.72      K ref =    0.000      K cr =    51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.      11  of Schedule No.    4612
Crack Size      c =  0.473002


                  FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
                DATE: 26-MAR-99   TIME: 09:40:39
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 11, PSE-W2 SA226 MS, crack in cap WS 9 (T

GEOMETRY
--------
MODEL: TC11-Corner crack in plate or bar (2D)

Plate Thickness, t =    0.1250
  "   Width, W     =    3.5500
Hole Diameter, D   =    0.2000
Hole-Center-to-Edge Dist., B =    0.6100
2ND AREA, AREATC11 =    3.7000
2ND M. INERTIA =    3.6000
2ND C.G. =    1.7750

FLAW SIZE:

c   (init.) =  0.1033



MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:
```

C-2 PSE W2 SA226 Main Spar Lower Cap at WS 9.0 (Continued)

```
MODEL: TC11

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    7.5000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    7.5000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    7.5000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    7.5000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.7600
Scale Factor for Stress S3:    0.0000

Total No. of Blocks in Schedule =     15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
    1  -     1                         1
    2  -     2                         2
    3  -     3                         5
    4  -     4                         1
    5  -     5                         3
    6  -     6                         5
    7  -     7                         1
    8  -     8                         3
    9  -     9                         5
   10  -    10                         1
   11  -    11                         3
   12  -    12                         5
   13  -    13                         1
   14  -    14                         4
   15  -    15                         5

BLOCK CASE NO.  1
 S   : M:  NUMBER     :        S0          :        S3          :
 T   : A:    OF       :                    :                    :
 E   : T:  FATIGUE    :                    :                    :
 P   : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.90 :    0.37:     0.97:    -0.30:      0.30:
   2: 1:        0.09 :    0.27:     1.07:    -0.40:      0.40:
   3: 1:        0.01 :    0.21:     1.13:    -0.46:      0.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
```

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	9.57	0.37	0.97	-0.30	0.30
2	1	1.14	0.17	1.17	-0.50	0.50
3	1	0.57	0.07	1.27	-0.60	0.60
4	1	0.11	-0.13	1.47	-0.80	0.80
5	1	0.02	-0.33	1.67	-1.00	1.00
6	1	0.01	-0.53	1.87	-1.20	1.20
7	1	0.00	-0.73	2.07	-1.40	1.40
8	1	0.00	-0.93	2.27	-1.60	1.60
9	1	0.00	-1.13	2.47	-1.80	1.80
10	1	0.00	-1.33	2.67	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	0.37	0.97	-0.30	0.30
2	1	2.29	0.17	1.17	-0.50	0.50
3	1	1.14	0.07	1.27	-0.60	0.60
4	1	0.23	-0.13	1.47	-0.80	0.80
5	1	0.04	-0.33	1.67	-1.00	1.00
6	1	0.01	-0.53	1.87	-1.20	1.20
7	1	0.00	-0.73	2.07	-1.40	1.40
8	1	0.00	-0.93	2.27	-1.60	1.60
9	1	0.00	-1.13	2.47	-1.80	1.80
10	1	0.00	-1.33	2.67	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	0.37	0.97	-0.30	0.30
2	1	4.57	0.17	1.17	-0.50	0.50
3	1	2.29	0.07	1.27	-0.60	0.60
4	1	0.46	-0.13	1.47	-0.80	0.80
5	1	0.08	-0.33	1.67	-1.00	1.00
6	1	0.02	-0.53	1.87	-1.20	1.20
7	1	0.01	-0.73	2.07	-1.40	1.40
8	1	0.00	-0.93	2.27	-1.60	1.60
9	1	0.00	-1.13	2.47	-1.80	1.80
10	1	0.00	-1.33	2.67	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01

C-2 PSE W2 SA226 Main Spar Lower Cap at WS 9.0 (Continued)

2:	1:	0.44 :	0.81:	1.12:	0.81:	1.12:
3:	1:	0.22 :	0.61:	1.23:	0.61:	1.23:
4:	1:	0.06 :	0.42:	1.33:	0.42:	1.33:
5:	1:	0.00 :	0.22:	2.44:	0.22:	2.44:
6:	1:	0.00 :	0.03:	2.55:	0.03:	2.55:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	1.90 :	2.78:	7.27:	0.00:	0.00:
2:	1:	0.09 :	2.03:	8.03:	0.00:	0.00:
3:	1:	0.01 :	1.58:	8.48:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	9.57 :	2.78:	7.27:	0.00:	0.00:
2:	1:	1.14 :	1.28:	8.77:	0.00:	0.00:
3:	1:	0.57 :	0.53:	9.53:	0.00:	0.00:
4:	1:	0.11 :	-0.98:	11.03:	0.00:	0.00:
5:	1:	0.02 :	-2.47:	12.52:	0.00:	0.00:
6:	1:	0.01 :	-3.97:	14.03:	0.00:	0.00:
7:	1:	0.00 :	-5.47:	15.52:	0.00:	0.00:
8:	1:	0.00 :	-6.98:	17.02:	0.00:	0.00:
9:	1:	0.00 :	-8.47:	18.53:	0.00:	0.00:
10:	1:	0.00 :	-9.98:	20.02:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	19.14 :	2.78:	7.27:	0.00:	0.00:
2:	1:	2.29 :	1.28:	8.77:	0.00:	0.00:
3:	1:	1.14 :	0.53:	9.53:	0.00:	0.00:
4:	1:	0.23 :	-0.98:	11.03:	0.00:	0.00:
5:	1:	0.04 :	-2.47:	12.52:	0.00:	0.00:
6:	1:	0.01 :	-3.97:	14.03:	0.00:	0.00:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
7:	1:	0.00 :	-5.47:	15.52:	0.00:	0.00:
8:	1:	0.00 :	-6.98:	17.02:	0.00:	0.00:
9:	1:	0.00 :	-8.47:	18.53:	0.00:	0.00:
10:	1:	0.00 :	-9.98:	20.02:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	38.29 :	2.78:	7.27:	0.00:	0.00:
2:	1:	4.57 :	1.28:	8.77:	0.00:	0.00:
3:	1:	2.29 :	0.53:	9.53:	0.00:	0.00:
4:	1:	0.46 :	-0.98:	11.03:	0.00:	0.00:
5:	1:	0.08 :	-2.47:	12.52:	0.00:	0.00:
6:	1:	0.02 :	-3.97:	14.03:	0.00:	0.00:
7:	1:	0.01 :	-5.47:	15.52:	0.00:	0.00:
8:	1:	0.00 :	-6.98:	17.02:	0.00:	0.00:
9:	1:	0.00 :	-8.47:	18.53:	0.00:	0.00:
10:	1:	0.00 :	-9.98:	20.02:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.28 :	3.76:	3.80:	0.00:	0.00:
2:	1:	0.44 :	3.05:	4.21:	0.00:	0.00:
3:	1:	0.22 :	2.29:	4.62:	0.00:	0.00:
4:	1:	0.06 :	1.58:	5.00:	0.00:	0.00:
5:	1:	0.00 :	0.83:	9.17:	0.00:	0.00:
6:	1:	0.00 :	0.11:	9.59:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

ANALYSIS RESULTS:

Schedl	Block Step	Final Flaw Size c	K max c-tip
200	15	0.113814	7.267272
400	15	0.124983	7.373118
600	15	0.136886	7.490825
800	15	0.149652	7.622938
1000	15	0.163447	7.772793

1200	15	0.178492	7.945044
1400	15	0.195092	8.146575
1600	15	0.213684	8.388235
1800	15	0.234947	8.688562
2000	15	0.260025	9.083050
2200	15	0.291176	9.653017
2400	15	0.334237	10.660162
2600	15	0.426895	15.052989

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     51.98      K ref =     0.000      K cr =     51.83
at the very beginning of Load Step No.    10
Step description:
of Block No.      14  of Schedule No.    2623
Crack Size      c =  0.480728

                  FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
                DATE: 26-MAR-99    TIME: 13:13:00
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W2 SA226 MS, cracked angle WS 9

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    1.7800
Hole Diameter, D   =    0.2000
Hole-Center-to-Edge Dist., B =    0.6100
Poisson s ratio    =    0.30

FLAW SIZE:

a   (init.) =  0.5000E-02
c   (init.) =  0.5000E-02
a/c (init.) =   1.000


MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
```

C-2 PSE W2 SA226 Main Spar Lower Cap at WS 9.0 (Continued)

```
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    8.8500
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    8.8500
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    8.8500
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    8.8500
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    4.4500
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                   Block Case No.
From   -   To
    1   -     1                             1
    2   -     2                             2
    3   -     3                             5
    4   -     4                             1
    5   -     5                             3
    6   -     6                             5
    7   -     7                             1
    8   -     8                             3
    9   -     9                             5
   10   -    10                             1
   11   -    11                             3
   12   -    12                             5
   13   -    13                             1
   14   -    14                             4
   15   -    15                             5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :        S0          :         S1          :
 T   : A:    OF        :                    :                     :
 E   : T:  FATIGUE     :                    :                     :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.37:      0.97:    0.70:      1.30:
   2: 1:         0.09 :    0.27:      1.07:    0.60:      1.40:
   3: 1:         0.01 :    0.21:      1.13:    0.54:      1.46:
 S   : M:  NUMBER      :        S3          :         S           :
 T   : A:    OF        :                    :                     :
 E   : T:  FATIGUE     :                    :                     :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)      :
```

1	1	1.90	0.70	1.30	0.00	0.00
2	1	0.09	0.60	1.40	0.00	0.00
3	1	0.01	0.54	1.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	9.57	0.37	0.97	0.70	1.30
2	1	1.14	0.17	1.17	0.50	1.50
3	1	0.57	0.07	1.27	0.40	1.60
4	1	0.11	-0.13	1.47	0.20	1.80
5	1	0.02	-0.33	1.67	0.00	2.00
6	1	0.01	-0.53	1.87	-0.20	2.20
7	1	0.00	-0.73	2.07	-0.40	2.40
8	1	0.00	-0.93	2.27	-0.60	2.60
9	1	0.00	-1.13	2.47	-0.80	2.80
10	1	0.00	-1.33	2.67	-1.00	3.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	9.57	0.70	1.30	0.00	0.00
2	1	1.14	0.50	1.50	0.00	0.00
3	1	0.57	0.40	1.60	0.00	0.00
4	1	0.11	0.20	1.80	0.00	0.00
5	1	0.02	0.00	2.00	0.00	0.00
6	1	0.01	-0.20	2.20	0.00	0.00
7	1	0.00	-0.40	2.40	0.00	0.00
8	1	0.00	-0.60	2.60	0.00	0.00
9	1	0.00	-0.80	2.80	0.00	0.00
10	1	0.00	-1.00	3.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.37	0.97	0.70	1.30
2	1	2.29	0.17	1.17	0.50	1.50
3	1	1.14	0.07	1.27	0.40	1.60
4	1	0.23	-0.13	1.47	0.20	1.80
5	1	0.04	-0.33	1.67	0.00	2.00
6	1	0.01	-0.53	1.87	-0.20	2.20
7	1	0.00	-0.73	2.07	-0.40	2.40
8	1	0.00	-0.93	2.27	-0.60	2.60
9	1	0.00	-1.13	2.47	-0.80	2.80
10	1	0.00	-1.33	2.67	-1.00	3.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	19.14	0.70	1.30	0.00	0.00
2	1	2.29	0.50	1.50	0.00	0.00
3	1	1.14	0.40	1.60	0.00	0.00

4:	1:	0.23 :	0.20:	1.80:	0.00:	0.00:
5:	1:	0.04 :	0.00:	2.00:	0.00:	0.00:
6:	1:	0.01 :	-0.20:	2.20:	0.00:	0.00:
7:	1:	0.00 :	-0.40:	2.40:	0.00:	0.00:
8:	1:	0.00 :	-0.60:	2.60:	0.00:	0.00:
9:	1:	0.00 :	-0.80:	2.80:	0.00:	0.00:
10:	1:	0.00 :	-1.00:	3.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	38.29 :	0.37:	0.97:	0.70:	1.30:
2:	1:	4.57 :	0.17:	1.17:	0.50:	1.50:
3:	1:	2.29 :	0.07:	1.27:	0.40:	1.60:
4:	1:	0.46 :	-0.13:	1.47:	0.20:	1.80:
5:	1:	0.08 :	-0.33:	1.67:	0.00:	2.00:
6:	1:	0.02 :	-0.53:	1.87:	-0.20:	2.20:
7:	1:	0.01 :	-0.73:	2.07:	-0.40:	2.40:
8:	1:	0.00 :	-0.93:	2.27:	-0.60:	2.60:
9:	1:	0.00 :	-1.13:	2.47:	-0.80:	2.80:
10:	1:	0.00 :	-1.33:	2.67:	-1.00:	3.00:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	38.29 :	0.70:	1.30:	0.00:	0.00:
2:	1:	4.57 :	0.50:	1.50:	0.00:	0.00:
3:	1:	2.29 :	0.40:	1.60:	0.00:	0.00:
4:	1:	0.46 :	0.20:	1.80:	0.00:	0.00:
5:	1:	0.08 :	0.00:	2.00:	0.00:	0.00:
6:	1:	0.02 :	-0.20:	2.20:	0.00:	0.00:
7:	1:	0.01 :	-0.40:	2.40:	0.00:	0.00:
8:	1:	0.00 :	-0.60:	2.60:	0.00:	0.00:
9:	1:	0.00 :	-0.80:	2.80:	0.00:	0.00:
10:	1:	0.00 :	-1.00:	3.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	0.28 :	1.00:	1.01:	1.00:	1.01:
2:	1:	0.44 :	0.81:	1.12:	0.81:	1.12:
3:	1:	0.22 :	0.61:	1.23:	0.61:	1.23:
4:	1:	0.06 :	0.42:	1.33:	0.42:	1.33:
5:	1:	0.00 :	0.22:	2.44:	0.22:	2.44:
6:	1:	0.00 :	0.03:	2.55:	0.03:	2.55:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	0.28 :	1.00:	1.01:	0.00:	0.00:
2:	1:	0.44 :	0.81:	1.12:	0.00:	0.00:
3:	1:	0.22 :	0.61:	1.23:	0.00:	0.00:
4:	1:	0.06 :	0.42:	1.33:	0.00:	0.00:

C-2 PSE W2 SA226 Main Spar Lower Cap at WS 9.0 (Continued)

5:	1:	0.00	0.22	2.44	0.00	0.00
6:	1:	0.00	0.03	2.55	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	1.90	3.27	8.58	0.00	0.00
2:	1:	0.09	2.39	9.47	0.00	0.00
3:	1:	0.01	1.86	10.00	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	1.90	0.00	0.00	0.00	0.00
2:	1:	0.09	0.00	0.00	0.00	0.00
3:	1:	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	9.57	3.27	8.58	0.00	0.00
2:	1:	1.14	1.50	10.35	0.00	0.00
3:	1:	0.57	0.62	11.24	0.00	0.00
4:	1:	0.11	-1.15	13.01	0.00	0.00
5:	1:	0.02	-2.92	14.78	0.00	0.00
6:	1:	0.01	-4.69	16.55	0.00	0.00
7:	1:	0.00	-6.46	18.32	0.00	0.00
8:	1:	0.00	-8.23	20.09	0.00	0.00
9:	1:	0.00	-10.00	21.86	0.00	0.00
10:	1:	0.00	-11.77	23.63	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	9.57	0.00	0.00	0.00	0.00
2:	1:	1.14	0.00	0.00	0.00	0.00
3:	1:	0.57	0.00	0.00	0.00	0.00
4:	1:	0.11	0.00	0.00	0.00	0.00
5:	1:	0.02	0.00	0.00	0.00	0.00
6:	1:	0.01	0.00	0.00	0.00	0.00
7:	1:	0.00	0.00	0.00	0.00	0.00
8:	1:	0.00	0.00	0.00	0.00	0.00
9:	1:	0.00	0.00	0.00	0.00	0.00
10:	1:	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	3.27	8.58	0.00	0.00
2	1	2.29	1.50	10.35	0.00	0.00
3	1	1.14	0.62	11.24	0.00	0.00
4	1	0.23	-1.15	13.01	0.00	0.00
5	1	0.04	-2.92	14.78	0.00	0.00
6	1	0.01	-4.69	16.55	0.00	0.00
7	1	0.00	-6.46	18.32	0.00	0.00
8	1	0.00	-8.23	20.09	0.00	0.00
9	1	0.00	-10.00	21.86	0.00	0.00
10	1	0.00	-11.77	23.63	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00
2	1	2.29	0.00	0.00	0.00	0.00
3	1	1.14	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.04	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	3.27	8.58	0.00	0.00
2	1	4.57	1.50	10.35	0.00	0.00
3	1	2.29	0.62	11.24	0.00	0.00
4	1	0.46	-1.15	13.01	0.00	0.00
5	1	0.08	-2.92	14.78	0.00	0.00
6	1	0.02	-4.69	16.55	0.00	0.00
7	1	0.01	-6.46	18.32	0.00	0.00
8	1	0.00	-8.23	20.09	0.00	0.00
9	1	0.00	-10.00	21.86	0.00	0.00
10	1	0.00	-11.77	23.63	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)

C-2 PSE W2 SA226 Main Spar Lower Cap at WS 9.0 (Continued)

1:	1:	38.29 :	0.00:	0.00:	0.00:	0.00:
2:	1:	4.57 :	0.00:	0.00:	0.00:	0.00:
3:	1:	2.29 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.46 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.08 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.02 :	0.00:	0.00:	0.00:	0.00:
7:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:
8:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
9:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
10:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28 :	4.45:	4.49:	0.00:	0.00:
2:	1:	0.44 :	3.60:	4.98:	0.00:	0.00:
3:	1:	0.22 :	2.71:	5.47:	0.00:	0.00:
4:	1:	0.06 :	1.87:	5.92:	0.00:	0.00:
5:	1:	0.00 :	0.98:	10.86:	0.00:	0.00:
6:	1:	0.00 :	0.13:	11.35:	0.00:	0.00:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	0.28 :	0.00:	0.00:	0.00:	0.00:
2:	1:	0.44 :	0.00:	0.00:	0.00:	0.00:
3:	1:	0.22 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.06 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W2
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15	0.005072	0.005061	2.800699	2.733908
400	15	0.005146	0.005124	2.818071	2.751992
600	15	0.005223	0.005190	2.835961	2.770468
800	15	0.005303	0.005258	2.854383	2.789353
1000	15	0.005385	0.005329	2.873356	2.808664
1200	15	0.005470	0.005403	2.892895	2.828420
1400	15	0.005559	0.005480	2.913021	2.848640
1600	15	0.005650	0.005559	2.933753	2.869342
1800	15	0.005745	0.005642	2.955112	2.890548
2000	15	0.005844	0.005728	2.977120	2.912279
2200	15	0.005946	0.005818	2.999805	2.934576
2400	15	0.006053	0.005911	3.023192	2.957456

C-2 PSE W2 SA226 Main Spar Lower Cap at WS 9.0 (Continued)

2600	15	0.006163	0.006008	3.047306	2.980940
2800	15	0.006279	0.006109	3.072178	3.005053
3000	15	0.006399	0.006214	3.097840	3.029820
3200	15	0.006524	0.006324	3.124338	3.055266
3400	15	0.006654	0.006439	3.151699	3.081423
3600	15	0.006791	0.006559	3.179959	3.108322
3800	15	0.006933	0.006684	3.209153	3.135999
4000	15	0.007082	0.006815	3.239322	3.164488
4200	15	0.007239	0.006952	3.270510	3.193826
4400	15	0.007402	0.007095	3.302763	3.224052
4600	15	0.007574	0.007246	3.336129	3.255208
4800	15	0.007754	0.007403	3.370659	3.287336
5000	15	0.007943	0.007568	3.406410	3.320483
5200	15	0.008142	0.007742	3.443440	3.354698
5400	15	0.008351	0.007924	3.481812	3.390031
5600	15	0.008572	0.008116	3.521591	3.426535
5800	15	0.008805	0.008318	3.562850	3.464269
6000	15	0.009052	0.008530	3.605662	3.503292
6200	15	0.009317	0.008755	3.650212	3.544617
6400	15	0.009618	0.008993	3.697039	3.591279
6600	15	0.009949	0.009247	3.746252	3.641766
6800	15	0.010311	0.009522	3.798556	3.695491
7000	15	0.010706	0.009839	3.857354	3.751472
7200	15	0.011140	0.010194	3.921492	3.810499
7400	15	0.011617	0.010587	3.990732	3.872996
7600	15	0.012143	0.011020	4.065176	3.939292
7800	15	0.012724	0.011498	4.145059	4.009705
8000	15	0.013368	0.012026	4.230699	4.084562
8200	15	0.014084	0.012610	4.322475	4.164210
8400	15	0.014882	0.013257	4.420821	4.249017
8600	15	0.015776	0.013975	4.526222	4.339378
8800	15	0.016781	0.014775	4.639208	4.435713
9000	15	0.017915	0.015669	4.760352	4.538473
9200	15	0.019198	0.016670	4.890268	4.648139
9400	15	0.020658	0.017795	5.029599	4.765230
9600	15	0.022325	0.019065	5.179013	4.890304
9800	15	0.024238	0.020503	5.339194	5.023978
10000	15	0.026441	0.022137	5.510827	5.166942

MODEL: CC02

ANALYSIS RESULTS (contd.)

Schdl	Block Step	Final Flaw Size a	c	K max a-tip	c-tip
10200	15	0.028990	0.024002	5.694594	5.320002
10400	15	0.031951	0.026141	5.891161	5.484143
10600	15	0.035405	0.028603	6.101197	5.660643
10800	15	0.039450	0.031454	6.325396	5.851208
11000	15	0.044207	0.034775	6.564558	6.058265
11200	15	0.049820	0.038672	6.819720	6.285405
11400	15	0.056471	0.043288	7.092384	6.538069
11600	15	0.064387	0.048826	7.384928	6.824691
11800	15	0.073861	0.055588	7.701233	7.158731
12000	15	0.085283	0.064056	8.047567	7.562384
12200	15	0.099198	0.075067	8.433694	8.073713
12400	15	0.116401	0.090237	8.872075	8.760538

Transition to 1-d solution, TC03:
a = 0.1250 t = 0.1250
at Cycle No. 1.14 of Load Step No. 3
Step description:
of Block No. 5 of Schedule No. 12486
Crack Size: c = 0.987142E-01 , a/c = 1.26630

Schedl Block Final Flaw Size K max

C-2 PSE W2 SA226 Main Spar Lower Cap at WS 9.0 (Continued)

	Step	c	c-tip
12600	15	0.112253	8.860408
12800	15	0.139087	9.243139
13000	15	0.171870	9.763985
13200	15	0.214869	10.550093
13400	15	0.280760	12.078710

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No. 10
Step description:
of Block No. 2 of Schedule No. 13532
Crack Size c = 0.372515

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No. 10
Step description:
of Block No. 8 of Schedule No. 13542
Crack Size c = 0.387877

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27

```
                    FATIGUE CRACK GROWTH ANALYSIS
                   -------Modified by FAI-------
                  DATE: 31-MAR-99    TIME: 08:39:28
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W3 SA226 RS, cracked angle WS 27 (N

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    1.2500
Hole Diameter, D   =    0.2500
Hole-Center-to-Edge Dist., B =    0.6100
Poisson s ratio    =    0.30

FLAW SIZE:

a   (init.) =  0.5000E-01
c   (init.) =  0.5000E-01
a/c (init.) =   1.000



MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  Kle :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    5.2200
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    6.1200

Stress Scaling Factors for Block Case:  2
```

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

Scale Factor for Stress S0: 5.2200
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 6.1200

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 5.2200
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 6.1200

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 5.2200
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 6.1200

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 1.7000
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 1.9900

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.38	0.98	0.70	1.30
2	1	0.09	0.28	1.08	0.60	1.40
3	1	0.01	0.22	1.14	0.54	1.46

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	1.90	0.38	0.98	0.00	0.00
2	1	0.09	0.28	1.08	0.00	0.00
3	1	0.01	0.22	1.14	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE	S0	S1

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	9.57	0.38	0.98	0.70	1.30
2	1	1.14	0.18	1.18	0.50	1.50
3	1	0.57	0.08	1.28	0.40	1.60
4	1	0.11	-0.12	1.48	0.20	1.80
5	1	0.02	-0.32	1.68	0.00	2.00
6	1	0.01	-0.52	1.88	-0.20	2.20
7	1	0.00	-0.72	2.08	-0.40	2.40
8	1	0.00	-0.92	2.28	-0.60	2.60
9	1	0.00	-1.12	2.48	-0.80	2.80
10	1	0.00	-1.32	2.68	-1.00	3.00

S	M	NUMBER	S3		S	
T	A	OF				
E	T	FATIGUE				
P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	9.57	0.38	0.98	0.00	0.00
2	1	1.14	0.18	1.18	0.00	0.00
3	1	0.57	0.08	1.28	0.00	0.00
4	1	0.11	-0.12	1.48	0.00	0.00
5	1	0.02	-0.32	1.68	0.00	0.00
6	1	0.01	-0.52	1.88	0.00	0.00
7	1	0.00	-0.72	2.08	0.00	0.00
8	1	0.00	-0.92	2.28	0.00	0.00
9	1	0.00	-1.12	2.48	0.00	0.00
10	1	0.00	-1.32	2.68	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

S	M	NUMBER	S0		S1	
T	A	OF				
E	T	FATIGUE				
P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	19.14	0.38	0.98	0.70	1.30
2	1	2.29	0.18	1.18	0.50	1.50
3	1	1.14	0.08	1.28	0.40	1.60
4	1	0.23	-0.12	1.48	0.20	1.80
5	1	0.04	-0.32	1.68	0.00	2.00
6	1	0.01	-0.52	1.88	-0.20	2.20
7	1	0.00	-0.72	2.08	-0.40	2.40
8	1	0.00	-0.92	2.28	-0.60	2.60
9	1	0.00	-1.12	2.48	-0.80	2.80
10	1	0.00	-1.32	2.68	-1.00	3.00

S	M	NUMBER	S3		S	
T	A	OF				
E	T	FATIGUE				
P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	19.14	0.38	0.98	0.00	0.00
2	1	2.29	0.18	1.18	0.00	0.00
3	1	1.14	0.08	1.28	0.00	0.00
4	1	0.23	-0.12	1.48	0.00	0.00
5	1	0.04	-0.32	1.68	0.00	0.00
6	1	0.01	-0.52	1.88	0.00	0.00
7	1	0.00	-0.72	2.08	0.00	0.00
8	1	0.00	-0.92	2.28	0.00	0.00
9	1	0.00	-1.12	2.48	0.00	0.00
10	1	0.00	-1.32	2.68	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.38	0.98	0.70	1.30
2	1	4.57	0.18	1.18	0.50	1.50
3	1	2.29	0.08	1.28	0.40	1.60
4	1	0.46	-0.12	1.48	0.20	1.80
5	1	0.08	-0.32	1.68	0.00	2.00
6	1	0.02	-0.52	1.88	-0.20	2.20
7	1	0.01	-0.72	2.08	-0.40	2.40
8	1	0.00	-0.92	2.28	-0.60	2.60
9	1	0.00	-1.12	2.48	-0.80	2.80
10	1	0.00	-1.32	2.68	-1.00	3.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	38.29	0.38	0.98	0.00	0.00
2	1	4.57	0.18	1.18	0.00	0.00
3	1	2.29	0.08	1.28	0.00	0.00
4	1	0.46	-0.12	1.48	0.00	0.00
5	1	0.08	-0.32	1.68	0.00	0.00
6	1	0.02	-0.52	1.88	0.00	0.00
7	1	0.01	-0.72	2.08	0.00	0.00
8	1	0.00	-0.92	2.28	0.00	0.00
9	1	0.00	-1.12	2.48	0.00	0.00
10	1	0.00	-1.32	2.68	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.75	1.23	0.75	1.23
3	1	0.22	0.50	1.46	0.50	1.46
4	1	0.06	0.26	1.69	0.26	1.69
5	1	0.00	0.01	1.92	0.01	1.92
6	1	0.00	-0.24	2.14	-0.24	2.14

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.01	0.00	0.00
2	1	0.44	0.75	1.23	0.00	0.00
3	1	0.22	0.50	1.46	0.00	0.00
4	1	0.06	0.26	1.69	0.00	0.00
5	1	0.00	0.01	1.92	0.00	0.00
6	1	0.00	-0.24	2.14	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S : M: NUMBER : S0 : S1 :

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

```
T  : A:   OF           :                    :                    :
E  : T:  FATIGUE       :      (ksi)         :       (ksi)        :
P  : L:  CYCLES        :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          1.90 :   1.98:      5.12:     0.00:     0.00:
   2: 1:          0.09 :   1.46:      5.64:     0.00:     0.00:
   3: 1:          0.01 :   1.15:      5.95:     0.00:     0.00:
S  : M:  NUMBER        :      S3            :       S            :
T  : A:   OF           :                    :                    :
E  : T:  FATIGUE       :      (ksi)         :       (ksi)        :
P  : L:  CYCLES        :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          1.90 :   2.33:      6.00:     0.00:     0.00:
   2: 1:          0.09 :   1.71:      6.61:     0.00:     0.00:
   3: 1:          0.01 :   1.35:      6.98:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S  : M:  NUMBER        :      S0            :       S1           :
T  : A:   OF           :                    :                    :
E  : T:  FATIGUE       :      (ksi)         :       (ksi)        :
P  : L:  CYCLES        :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          9.57 :   1.98:      5.12:     0.00:     0.00:
   2: 1:          1.14 :   0.94:      6.16:     0.00:     0.00:
   3: 1:          0.57 :   0.42:      6.68:     0.00:     0.00:
   4: 1:          0.11 :  -0.63:      7.73:     0.00:     0.00:
   5: 1:          0.02 :  -1.67:      8.77:     0.00:     0.00:
   6: 1:          0.01 :  -2.71:      9.81:     0.00:     0.00:
   7: 1:          0.00 :  -3.76:     10.86:     0.00:     0.00:
   8: 1:          0.00 :  -4.80:     11.90:     0.00:     0.00:
   9: 1:          0.00 :  -5.85:     12.95:     0.00:     0.00:
  10: 1:          0.00 :  -6.89:     13.99:     0.00:     0.00:
S  : M:  NUMBER        :      S3            :       S            :
T  : A:   OF           :                    :                    :
E  : T:  FATIGUE       :      (ksi)         :       (ksi)        :
P  : L:  CYCLES        :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          9.57 :   2.33:      6.00:     0.00:     0.00:
   2: 1:          1.14 :   1.10:      7.22:     0.00:     0.00:
   3: 1:          0.57 :   0.49:      7.83:     0.00:     0.00:
   4: 1:          0.11 :  -0.73:      9.06:     0.00:     0.00:
   5: 1:          0.02 :  -1.96:     10.28:     0.00:     0.00:
   6: 1:          0.01 :  -3.18:     11.51:     0.00:     0.00:
   7: 1:          0.00 :  -4.41:     12.73:     0.00:     0.00:
   8: 1:          0.00 :  -5.63:     13.95:     0.00:     0.00:
   9: 1:          0.00 :  -6.85:     15.18:     0.00:     0.00:
  10: 1:          0.00 :  -8.08:     16.40:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S  : M:  NUMBER        :      S0            :       S1           :
T  : A:   OF           :                    :                    :
E  : T:  FATIGUE       :      (ksi)         :       (ksi)        :
P  : L:  CYCLES        :   (t1) :  (t2)     :   (t1) :  (t2)     :
```

1	1	19.14	1.98	5.12	0.00	0.00
2	1	2.29	0.94	6.16	0.00	0.00
3	1	1.14	0.42	6.68	0.00	0.00
4	1	0.23	-0.63	7.73	0.00	0.00
5	1	0.04	-1.67	8.77	0.00	0.00
6	1	0.01	-2.71	9.81	0.00	0.00
7	1	0.00	-3.76	10.86	0.00	0.00
8	1	0.00	-4.80	11.90	0.00	0.00
9	1	0.00	-5.85	12.95	0.00	0.00
10	1	0.00	-6.89	13.99	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	2.33	6.00	0.00	0.00
2	1	2.29	1.10	7.22	0.00	0.00
3	1	1.14	0.49	7.83	0.00	0.00
4	1	0.23	-0.73	9.06	0.00	0.00
5	1	0.04	-1.96	10.28	0.00	0.00
6	1	0.01	-3.18	11.51	0.00	0.00
7	1	0.00	-4.41	12.73	0.00	0.00
8	1	0.00	-5.63	13.95	0.00	0.00
9	1	0.00	-6.85	15.18	0.00	0.00
10	1	0.00	-8.08	16.40	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	1.98	5.12	0.00	0.00
2	1	4.57	0.94	6.16	0.00	0.00
3	1	2.29	0.42	6.68	0.00	0.00
4	1	0.46	-0.63	7.73	0.00	0.00
5	1	0.08	-1.67	8.77	0.00	0.00
6	1	0.02	-2.71	9.81	0.00	0.00
7	1	0.01	-3.76	10.86	0.00	0.00
8	1	0.00	-4.80	11.90	0.00	0.00
9	1	0.00	-5.85	12.95	0.00	0.00
10	1	0.00	-6.89	13.99	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	38.29	2.33	6.00	0.00	0.00
2	1	4.57	1.10	7.22	0.00	0.00
3	1	2.29	0.49	7.83	0.00	0.00
4	1	0.46	-0.73	9.06	0.00	0.00
5	1	0.08	-1.96	10.28	0.00	0.00
6	1	0.02	-3.18	11.51	0.00	0.00
7	1	0.01	-4.41	12.73	0.00	0.00
8	1	0.00	-5.63	13.95	0.00	0.00
9	1	0.00	-6.85	15.18	0.00	0.00
10	1	0.00	-8.08	16.40	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.28	1.70	1.72	0.00	0.00
2	1	0.44	1.27	2.09	0.00	0.00
3	1	0.22	0.85	2.48	0.00	0.00
4	1	0.06	0.44	2.87	0.00	0.00
5	1	0.00	0.02	3.26	0.00	0.00
6	1	0.00	-0.41	3.64	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	1.99	2.01	0.00	0.00
2	1	0.44	1.49	2.45	0.00	0.00
3	1	0.22	0.99	2.91	0.00	0.00
4	1	0.06	0.52	3.36	0.00	0.00
5	1	0.00	0.02	3.82	0.00	0.00
6	1	0.00	-0.48	4.26	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block	Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15		0.058256	0.052979	4.010170	3.270166
400	15		0.067463	0.057026	4.116178	3.484762
600	15		0.077850	0.062354	4.238133	3.698723
800	15		0.089740	0.069284	4.379787	3.925557
1000	15		0.103582	0.078362	4.544698	4.183285
1200	15		0.119998	0.090583	4.736509	4.497848

Transition to 1-d solution, TC03:
a = 0.1250 t = 0.1250
at Cycle No. 1.14 of Load Step No. 3
Step description:
of Block No. 5 of Schedule No. 1255
Crack Size: c = 0.946588E-01 , a/c = 1.32055

Schedl	Block	Step	Final Flaw Size c	K max c-tip
1400	15		0.103752	4.099436
1600	15		0.116641	4.139150
1800	15		0.130101	4.186139
2000	15		0.144268	4.242312
2200	15		0.159323	4.309948
2400	15		0.175507	4.392180
2600	15		0.193165	4.493743
2800	15		0.212804	4.622413

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

3000	15	0.235248	4.792262
3200	15	0.262001	5.032667
3400	15	0.296423	5.421829
3600	15	0.350306	6.326747

```
ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.   10
Step description:
of Block No.      14  of Schedule No.    3646
Crack Size      c =  0.370969

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No.   10
Step description:
of Block No.       2  of Schedule No.    3663
Crack Size      c =  0.380291


                  FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
                DATE: 31-MAR-99   TIME: 09:21:14
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 11, PSE-W3 SA226 RS, cracked angle WS 27

GEOMETRY
--------
MODEL: TC11-Corner crack in plate or bar (2D)

Plate Thickness, t =     0.1250
  "   Width, W      =     1.2500
Hole Diameter, D   =     0.2500
Hole-Center-to-Edge Dist., B =    0.6100
2ND AREA, AREATC11 =     0.8300
2ND M. INERTIA =     0.1460
2ND C.G. =    -0.5200

FLAW SIZE:

c   (init.) =  0.9466E-01



MATERIAL
--------

MATL 1:
       1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak  :  Bk  :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :      :      :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
```

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

```
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC11

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    5.2200
Scale Factor for Stress S3:    6.1200

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    5.2200
Scale Factor for Stress S3:    6.1200

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    5.2200
Scale Factor for Stress S3:    6.1200

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    5.2200
Scale Factor for Stress S3:    6.1200

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    1.7000
Scale Factor for Stress S3:    1.9900

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                    Block Case No.
From   -   To
    1   -      1                              1
    2   -      2                              2
    3   -      3                              5
    4   -      4                              1
    5   -      5                              3
    6   -      6                              5
    7   -      7                              1
    8   -      8                              3
    9   -      9                              5
   10   -     10                              1
   11   -     11                              3
   12   -     12                              5
   13   -     13                              1
   14   -     14                              4
   15   -     15                              5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :         S0          :         S3          :
 T   : A:    OF        :                     :                     :
 E   : T:  FATIGUE     :                     :                     :
 P   : L:  CYCLES      :  (t1) :  (t2)       :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.90 :    0.38:     0.98:    0.38:     0.98:
   2: 1:        0.09 :    0.28:     1.08:    0.28:     1.08:
   3: 1:        0.01 :    0.22:     1.14:    0.22:     1.14:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
```

BLOCK CASE NO. 2

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	9.57	0.38	0.98	0.38	0.98
2	1	1.14	0.18	1.18	0.18	1.18
3	1	0.57	0.08	1.28	0.08	1.28
4	1	0.11	-0.12	1.48	-0.12	1.48
5	1	0.02	-0.32	1.68	-0.32	1.68
6	1	0.01	-0.52	1.88	-0.52	1.88
7	1	0.00	-0.72	2.08	-0.72	2.08
8	1	0.00	-0.92	2.28	-0.92	2.28
9	1	0.00	-1.12	2.48	-1.12	2.48
10	1	0.00	-1.32	2.68	-1.32	2.68

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	0.38	0.98	0.38	0.98
2	1	2.29	0.18	1.18	0.18	1.18
3	1	1.14	0.08	1.28	0.08	1.28
4	1	0.23	-0.12	1.48	-0.12	1.48
5	1	0.04	-0.32	1.68	-0.32	1.68
6	1	0.01	-0.52	1.88	-0.52	1.88
7	1	0.00	-0.72	2.08	-0.72	2.08
8	1	0.00	-0.92	2.28	-0.92	2.28
9	1	0.00	-1.12	2.48	-1.12	2.48
10	1	0.00	-1.32	2.68	-1.32	2.68

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	0.38	0.98	0.38	0.98
2	1	4.57	0.18	1.18	0.18	1.18
3	1	2.29	0.08	1.28	0.08	1.28
4	1	0.46	-0.12	1.48	-0.12	1.48
5	1	0.08	-0.32	1.68	-0.32	1.68
6	1	0.02	-0.52	1.88	-0.52	1.88
7	1	0.01	-0.72	2.08	-0.72	2.08
8	1	0.00	-0.92	2.28	-0.92	2.28
9	1	0.00	-1.12	2.48	-1.12	2.48
10	1	0.00	-1.32	2.68	-1.32	2.68

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

1:	1:	0.28	1.00	1.01	1.00	1.01
2:	1:	0.44	0.75	1.23	0.75	1.23
3:	1:	0.22	0.50	1.46	0.50	1.46
4:	1:	0.06	0.26	1.69	0.26	1.69
5:	1:	0.00	0.01	1.92	0.01	1.92
6:	1:	0.00	-0.24	2.14	-0.24	2.14

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	1.90	1.98	5.12	2.33	6.00
2:	1:	0.09	1.46	5.64	1.71	6.61
3:	1:	0.01	1.15	5.95	1.35	6.98

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	9.57	1.98	5.12	2.33	6.00
2:	1:	1.14	0.94	6.16	1.10	7.22
3:	1:	0.57	0.42	6.68	0.49	7.83
4:	1:	0.11	-0.63	7.73	-0.73	9.06
5:	1:	0.02	-1.67	8.77	-1.96	10.28
6:	1:	0.01	-2.71	9.81	-3.18	11.51
7:	1:	0.00	-3.76	10.86	-4.41	12.73
8:	1:	0.00	-4.80	11.90	-5.63	13.95
9:	1:	0.00	-5.85	12.95	-6.85	15.18
10:	1:	0.00	-6.89	13.99	-8.08	16.40

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	19.14	1.98	5.12	2.33	6.00
2:	1:	2.29	0.94	6.16	1.10	7.22
3:	1:	1.14	0.42	6.68	0.49	7.83
4:	1:	0.23	-0.63	7.73	-0.73	9.06

5:	1:	0.04 :	-1.67:	8.77:	-1.96:	10.28:
6:	1:	0.01 :	-2.71:	9.81:	-3.18:	11.51:
7:	1:	0.00 :	-3.76:	10.86:	-4.41:	12.73:
8:	1:	0.00 :	-4.80:	11.90:	-5.63:	13.95:
9:	1:	0.00 :	-5.85:	12.95:	-6.85:	15.18:
10:	1:	0.00 :	-6.89:	13.99:	-8.08:	16.40:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	38.29 :	1.98:	5.12:	2.33:	6.00:
2:	1:	4.57 :	0.94:	6.16:	1.10:	7.22:
3:	1:	2.29 :	0.42:	6.68:	0.49:	7.83:
4:	1:	0.46 :	-0.63:	7.73:	-0.73:	9.06:
5:	1:	0.08 :	-1.67:	8.77:	-1.96:	10.28:
6:	1:	0.02 :	-2.71:	9.81:	-3.18:	11.51:
7:	1:	0.01 :	-3.76:	10.86:	-4.41:	12.73:
8:	1:	0.00 :	-4.80:	11.90:	-5.63:	13.95:
9:	1:	0.00 :	-5.85:	12.95:	-6.85:	15.18:
10:	1:	0.00 :	-6.89:	13.99:	-8.08:	16.40:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.28 :	1.70:	1.72:	1.99:	2.01:
2:	1:	0.44 :	1.27:	2.09:	1.49:	2.45:
3:	1:	0.22 :	0.85:	2.48:	0.99:	2.91:
4:	1:	0.06 :	0.44:	2.87:	0.52:	3.36:
5:	1:	0.00 :	0.02:	3.26:	0.02:	3.82:
6:	1:	0.00 :	-0.41:	3.64:	-0.48:	4.26:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.103930	3.809243
400	15		0.113181	3.808882
600	15		0.122433	3.810441

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

800	15	0.131706	3.814111
1000	15	0.141025	3.820006
1200	15	0.150414	3.828213
1400	15	0.159898	3.838823
1600	15	0.169504	3.851955
1800	15	0.179263	3.867767
2000	15	0.189206	3.886476
2200	15	0.199370	3.908374
2400	15	0.209797	3.933857
2600	15	0.220535	3.963454
2800	15	0.231646	3.997884
3000	15	0.243202	4.038134
3200	15	0.255299	4.085589
3400	15	0.268062	4.142255
3600	15	0.281663	4.211156
3800	15	0.296351	4.297111
4000	15	0.312514	4.408425
4200	15	0.330810	4.561112
4400	15	0.352542	4.792123
4600	15	0.381084	5.221430
4800	15	0.438169	7.229061

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     54.01      K ref =     0.000      K cr =     51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.       8  of Schedule No.    4824
Crack Size      c =  0.473689


                   FATIGUE CRACK GROWTH ANALYSIS
                  -------Modified by FAI-------
                DATE: 31-MAR-99    TIME: 09:46:45
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W3 SA226 RS, cracked angle WS 27 (N

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    1.2500
Hole Diameter, D   =    0.2500
Hole-Center-to-Edge Dist., B =    0.6100
Poisson s ratio    =    0.30

FLAW SIZE:

a   (init.) =  0.5000E-02
c   (init.) =  0.5000E-02
a/c (init.) =   1.000



MATERIAL
--------

MATL 1:
        1        2014T6511 EXTRUSION T-L

Material Properties:
```

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

Matl No.	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	74.0	65.0	27.0	27.0	1.00	1.00	0.125	51.8	

Matl No.	C	n	p	q	DKo	Rcl	Alpha	Smax/ SIGo
	Crack Growth Eqn Constants							
1	0.200D-08	3.700	0.50	1.00	2.70	0.70	5.84	1.00

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0: 5.2200
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 6.1200

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 5.2200
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 6.1200

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 5.2200
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 6.1200

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 5.2200
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 6.1200

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 1.7000
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 1.9900

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

```
BLOCK CASE NO.  1
S   : M:  NUMBER      :        S0           :        S1          :
T   : A:    OF        :                     :                    :
E   : T:  FATIGUE     :                     :                    :
P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.38:     0.98:     0.70:     1.30:
   2: 1:         0.09 :    0.28:     1.08:     0.60:     1.40:
   3: 1:         0.01 :    0.22:     1.14:     0.54:     1.46:
S   : M:  NUMBER      :        S3           :        S           :
T   : A:    OF        :                     :                    :
E   : T:  FATIGUE     :                     :                    :
P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.38:     0.98:     0.00:     0.00:
   2: 1:         0.09 :    0.28:     1.08:     0.00:     0.00:
   3: 1:         0.01 :    0.22:     1.14:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
S   : M:  NUMBER      :        S0           :        S1          :
T   : A:    OF        :                     :                    :
E   : T:  FATIGUE     :                     :                    :
P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :    0.38:     0.98:     0.70:     1.30:
   2: 1:         1.14 :    0.18:     1.18:     0.50:     1.50:
   3: 1:         0.57 :    0.08:     1.28:     0.40:     1.60:
   4: 1:         0.11 :   -0.12:     1.48:     0.20:     1.80:
   5: 1:         0.02 :   -0.32:     1.68:     0.00:     2.00:
   6: 1:         0.01 :   -0.52:     1.88:    -0.20:     2.20:
   7: 1:         0.00 :   -0.72:     2.08:    -0.40:     2.40:
   8: 1:         0.00 :   -0.92:     2.28:    -0.60:     2.60:
   9: 1:         0.00 :   -1.12:     2.48:    -0.80:     2.80:
  10: 1:         0.00 :   -1.32:     2.68:    -1.00:     3.00:
S   : M:  NUMBER      :        S3           :        S           :
T   : A:    OF        :                     :                    :
E   : T:  FATIGUE     :                     :                    :
P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :    0.38:     0.98:     0.00:     0.00:
   2: 1:         1.14 :    0.18:     1.18:     0.00:     0.00:
   3: 1:         0.57 :    0.08:     1.28:     0.00:     0.00:
   4: 1:         0.11 :   -0.12:     1.48:     0.00:     0.00:
   5: 1:         0.02 :   -0.32:     1.68:     0.00:     0.00:
   6: 1:         0.01 :   -0.52:     1.88:     0.00:     0.00:
   7: 1:         0.00 :   -0.72:     2.08:     0.00:     0.00:
   8: 1:         0.00 :   -0.92:     2.28:     0.00:     0.00:
   9: 1:         0.00 :   -1.12:     2.48:     0.00:     0.00:
  10: 1:         0.00 :   -1.32:     2.68:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
S   : M:  NUMBER      :        S0           :        S1          :
T   : A:    OF        :                     :                    :
E   : T:  FATIGUE     :                     :                    :
P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        19.14 :    0.38:     0.98:     0.70:     1.30:
   2: 1:         2.29 :    0.18:     1.18:     0.50:     1.50:
   3: 1:         1.14 :    0.08:     1.28:     0.40:     1.60:
   4: 1:         0.23 :   -0.12:     1.48:     0.20:     1.80:
```

5	1	0.04	-0.32	1.68	0.00	2.00
6	1	0.01	-0.52	1.88	-0.20	2.20
7	1	0.00	-0.72	2.08	-0.40	2.40
8	1	0.00	-0.92	2.28	-0.60	2.60
9	1	0.00	-1.12	2.48	-0.80	2.80
10	1	0.00	-1.32	2.68	-1.00	3.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	19.14	0.38	0.98	0.00	0.00
2	1	2.29	0.18	1.18	0.00	0.00
3	1	1.14	0.08	1.28	0.00	0.00
4	1	0.23	-0.12	1.48	0.00	0.00
5	1	0.04	-0.32	1.68	0.00	0.00
6	1	0.01	-0.52	1.88	0.00	0.00
7	1	0.00	-0.72	2.08	0.00	0.00
8	1	0.00	-0.92	2.28	0.00	0.00
9	1	0.00	-1.12	2.48	0.00	0.00
10	1	0.00	-1.32	2.68	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.38	0.98	0.70	1.30
2	1	4.57	0.18	1.18	0.50	1.50
3	1	2.29	0.08	1.28	0.40	1.60
4	1	0.46	-0.12	1.48	0.20	1.80
5	1	0.08	-0.32	1.68	0.00	2.00
6	1	0.02	-0.52	1.88	-0.20	2.20
7	1	0.01	-0.72	2.08	-0.40	2.40
8	1	0.00	-0.92	2.28	-0.60	2.60
9	1	0.00	-1.12	2.48	-0.80	2.80
10	1	0.00	-1.32	2.68	-1.00	3.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	38.29	0.38	0.98	0.00	0.00
2	1	4.57	0.18	1.18	0.00	0.00
3	1	2.29	0.08	1.28	0.00	0.00
4	1	0.46	-0.12	1.48	0.00	0.00
5	1	0.08	-0.32	1.68	0.00	0.00
6	1	0.02	-0.52	1.88	0.00	0.00
7	1	0.01	-0.72	2.08	0.00	0.00
8	1	0.00	-0.92	2.28	0.00	0.00
9	1	0.00	-1.12	2.48	0.00	0.00
10	1	0.00	-1.32	2.68	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01

2	1	0.44	0.75	1.23	0.75	1.23
3	1	0.22	0.50	1.46	0.50	1.46
4	1	0.06	0.26	1.69	0.26	1.69
5	1	0.00	0.01	1.92	0.01	1.92
6	1	0.00	-0.24	2.14	-0.24	2.14

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.01	0.00	0.00
2	1	0.44	0.75	1.23	0.00	0.00
3	1	0.22	0.50	1.46	0.00	0.00
4	1	0.06	0.26	1.69	0.00	0.00
5	1	0.00	0.01	1.92	0.00	0.00
6	1	0.00	-0.24	2.14	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	1.98	5.12	0.00	0.00
2	1	0.09	1.46	5.64	0.00	0.00
3	1	0.01	1.15	5.95	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	2.33	6.00	0.00	0.00
2	1	0.09	1.71	6.61	0.00	0.00
3	1	0.01	1.35	6.98	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	1.98	5.12	0.00	0.00
2	1	1.14	0.94	6.16	0.00	0.00
3	1	0.57	0.42	6.68	0.00	0.00
4	1	0.11	-0.63	7.73	0.00	0.00
5	1	0.02	-1.67	8.77	0.00	0.00
6	1	0.01	-2.71	9.81	0.00	0.00
7	1	0.00	-3.76	10.86	0.00	0.00
8	1	0.00	-4.80	11.90	0.00	0.00
9	1	0.00	-5.85	12.95	0.00	0.00
10	1	0.00	-6.89	13.99	0.00	0.00

STEP	MAT	NUMBER OF	S3		S	

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

E P	T: L:	FATIGUE CYCLES	(ksi) (t1)	(t2)	(ksi) (t1)	(t2)
1:	1:	9.57	2.33:	6.00:	0.00:	0.00:
2:	1:	1.14	1.10:	7.22:	0.00:	0.00:
3:	1:	0.57	0.49:	7.83:	0.00:	0.00:
4:	1:	0.11	-0.73:	9.06:	0.00:	0.00:
5:	1:	0.02	-1.96:	10.28:	0.00:	0.00:
6:	1:	0.01	-3.18:	11.51:	0.00:	0.00:
7:	1:	0.00	-4.41:	12.73:	0.00:	0.00:
8:	1:	0.00	-5.63:	13.95:	0.00:	0.00:
9:	1:	0.00	-6.85:	15.18:	0.00:	0.00:
10:	1:	0.00	-8.08:	16.40:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	19.14	1.98:	5.12:	0.00:	0.00:
2:	1:	2.29	0.94:	6.16:	0.00:	0.00:
3:	1:	1.14	0.42:	6.68:	0.00:	0.00:
4:	1:	0.23	-0.63:	7.73:	0.00:	0.00:
5:	1:	0.04	-1.67:	8.77:	0.00:	0.00:
6:	1:	0.01	-2.71:	9.81:	0.00:	0.00:
7:	1:	0.00	-3.76:	10.86:	0.00:	0.00:
8:	1:	0.00	-4.80:	11.90:	0.00:	0.00:
9:	1:	0.00	-5.85:	12.95:	0.00:	0.00:
10:	1:	0.00	-6.89:	13.99:	0.00:	0.00:

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	19.14	2.33:	6.00:	0.00:	0.00:
2:	1:	2.29	1.10:	7.22:	0.00:	0.00:
3:	1:	1.14	0.49:	7.83:	0.00:	0.00:
4:	1:	0.23	-0.73:	9.06:	0.00:	0.00:
5:	1:	0.04	-1.96:	10.28:	0.00:	0.00:
6:	1:	0.01	-3.18:	11.51:	0.00:	0.00:
7:	1:	0.00	-4.41:	12.73:	0.00:	0.00:
8:	1:	0.00	-5.63:	13.95:	0.00:	0.00:
9:	1:	0.00	-6.85:	15.18:	0.00:	0.00:
10:	1:	0.00	-8.08:	16.40:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	38.29	1.98:	5.12:	0.00:	0.00:

```
   2: 1:         4.57 :    0.94:     6.16:     0.00:     0.00:
   3: 1:         2.29 :    0.42:     6.68:     0.00:     0.00:
   4: 1:         0.46 :   -0.63:     7.73:     0.00:     0.00:
   5: 1:         0.08 :   -1.67:     8.77:     0.00:     0.00:
   6: 1:         0.02 :   -2.71:     9.81:     0.00:     0.00:
   7: 1:         0.01 :   -3.76:    10.86:     0.00:     0.00:
   8: 1:         0.00 :   -4.80:    11.90:     0.00:     0.00:
   9: 1:         0.00 :   -5.85:    12.95:     0.00:     0.00:
  10: 1:         0.00 :   -6.89:    13.99:     0.00:     0.00:
 S  : M:  NUMBER      :        S3          :        S          :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :      (ksi)         :      (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        38.29 :    2.33:     6.00:     0.00:     0.00:
   2: 1:         4.57 :    1.10:     7.22:     0.00:     0.00:
   3: 1:         2.29 :    0.49:     7.83:     0.00:     0.00:
   4: 1:         0.46 :   -0.73:     9.06:     0.00:     0.00:
   5: 1:         0.08 :   -1.96:    10.28:     0.00:     0.00:
   6: 1:         0.02 :   -3.18:    11.51:     0.00:     0.00:
   7: 1:         0.01 :   -4.41:    12.73:     0.00:     0.00:
   8: 1:         0.00 :   -5.63:    13.95:     0.00:     0.00:
   9: 1:         0.00 :   -6.85:    15.18:     0.00:     0.00:
  10: 1:         0.00 :   -8.08:    16.40:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
 S  : M:  NUMBER      :        S0          :        S1         :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :      (ksi)         :      (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.28 :    1.70:     1.72:     0.00:     0.00:
   2: 1:         0.44 :    1.27:     2.09:     0.00:     0.00:
   3: 1:         0.22 :    0.85:     2.48:     0.00:     0.00:
   4: 1:         0.06 :    0.44:     2.87:     0.00:     0.00:
   5: 1:         0.00 :    0.02:     3.26:     0.00:     0.00:
   6: 1:         0.00 :   -0.41:     3.64:     0.00:     0.00:
 S  : M:  NUMBER      :        S3          :        S          :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :      (ksi)         :      (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.28 :    1.99:     2.01:     0.00:     0.00:
   2: 1:         0.44 :    1.49:     2.45:     0.00:     0.00:
   3: 1:         0.22 :    0.99:     2.91:     0.00:     0.00:
   4: 1:         0.06 :    0.52:     3.36:     0.00:     0.00:
   5: 1:         0.00 :    0.02:     3.82:     0.00:     0.00:
   6: 1:         0.00 :   -0.48:     4.26:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W3
MODEL: CC02

ANALYSIS RESULTS:
-----------------


 Schdl      Block          Final Flaw Size           K max
```

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

	Step	a	c	a-tip	c-tip
200	15	0.005056	0.005046	1.459126	1.425933
400	15	0.005113	0.005093	1.465993	1.433276
600	15	0.005171	0.005143	1.473054	1.440753
800	15	0.005232	0.005193	1.480313	1.448371
1000	15	0.005294	0.005246	1.487772	1.456133
1200	15	0.005358	0.005301	1.495437	1.464047
1400	15	0.005424	0.005357	1.503311	1.472118
1600	15	0.005492	0.005415	1.511399	1.480351
1800	15	0.005562	0.005476	1.519706	1.488752
2000	15	0.005634	0.005538	1.528238	1.497328
2200	15	0.005708	0.005603	1.537000	1.506084
2400	15	0.005785	0.005669	1.545998	1.515027
2600	15	0.005864	0.005739	1.555240	1.524165
2800	15	0.005946	0.005810	1.564731	1.533503
3000	15	0.006030	0.005884	1.574480	1.543050
3200	15	0.006118	0.005961	1.584494	1.552812
3400	15	0.006208	0.006040	1.594781	1.562799
3600	15	0.006302	0.006122	1.605351	1.573017
3800	15	0.006399	0.006208	1.616212	1.583475
4000	15	0.006499	0.006296	1.627375	1.594183
4200	15	0.006603	0.006387	1.638849	1.605150
4400	15	0.006711	0.006482	1.650646	1.616393
4600	15	0.006823	0.006581	1.662779	1.627921
4800	15	0.006939	0.006683	1.675259	1.639744
5000	15	0.007060	0.006789	1.688100	1.651870
5200	15	0.007185	0.006899	1.701314	1.664312
5400	15	0.007316	0.007014	1.714925	1.677078
5600	15	0.007452	0.007133	1.728943	1.690183
5800	15	0.007593	0.007258	1.743385	1.703640
6000	15	0.007741	0.007387	1.758266	1.717463
6200	15	0.007895	0.007522	1.773603	1.731667
6400	15	0.008056	0.007662	1.789415	1.746268
6600	15	0.008224	0.007809	1.805721	1.761282
6800	15	0.008399	0.007962	1.822542	1.776725
7000	15	0.008583	0.008121	1.839901	1.792616
7200	15	0.008775	0.008288	1.857819	1.808973
7400	15	0.008977	0.008463	1.876322	1.825815
7600	15	0.009188	0.008645	1.895436	1.843163
7800	15	0.009410	0.008836	1.915187	1.861038
8000	15	0.009644	0.009037	1.935605	1.879463
8200	15	0.009889	0.009247	1.956720	1.898462
8400	15	0.010147	0.009467	1.978564	1.918058
8600	15	0.010432	0.009699	2.001312	1.939504
8800	15	0.010749	0.009945	2.025130	1.963235
9000	15	0.011095	0.010205	2.050061	1.988650
9200	15	0.011470	0.010485	2.076384	2.015536
9400	15	0.011878	0.010805	2.105802	2.043364
9600	15	0.012321	0.011161	2.137749	2.072512
9800	15	0.012805	0.011553	2.172064	2.103180
10000	15	0.013334	0.011982	2.208759	2.135509

MODEL: CC02

ANALYSIS RESULTS (contd.)

Schdl	Block	Final Flaw Size		K max	
	Step	a	c	a-tip	c-tip
10200	15	0.013913	0.012452	2.247913	2.169626
10400	15	0.014550	0.012965	2.289637	2.205660
10600	15	0.015250	0.013528	2.334069	2.243742
10800	15	0.016024	0.014146	2.381370	2.284008
11000	15	0.016880	0.014824	2.431715	2.326601
11200	15	0.017831	0.015570	2.485297	2.371670
11400	15	0.018889	0.016393	2.542325	2.419372
11600	15	0.020071	0.017303	2.603017	2.469869

C-3 PSE W3 SA226 Rear Spar Lower Cap at WS 27 (Continued)

11800	15	0.021396	0.018311	2.667604	2.523334
12000	15	0.022885	0.019432	2.736324	2.579948
12200	15	0.024564	0.020680	2.809418	2.639903
12400	15	0.026463	0.022073	2.887132	2.703409
12600	15	0.028620	0.023634	2.969706	2.770697
12800	15	0.031076	0.025388	3.057378	2.842037
13000	15	0.033882	0.027363	3.150383	2.917751
13200	15	0.037098	0.029596	3.248953	2.998253
13400	15	0.040794	0.032130	3.353335	3.084087
13600	15	0.045055	0.035016	3.463805	3.176003
13800	15	0.049981	0.038320	3.580714	3.275066
14000	15	0.055692	0.042125	3.704545	3.382820
14200	15	0.062335	0.046541	3.836010	3.501532
14400	15	0.070092	0.051719	3.976195	3.634599
14600	15	0.079189	0.057875	4.126771	3.787159
14800	15	0.089926	0.065339	4.290267	3.967187
15000	15	0.102704	0.074640	4.470362	4.187401
15200	15	0.118083	0.086701	4.671658	4.468566

```
Transition to 1-d solution, TC03:
a =   0.1250      t =   0.1250
at Cycle No.         1.14  of Load Step No.   3
Step description:
of Block No.     11  of Schedule No.   15279
Crack Size:  c =  0.925373E-01 ,  a/c =    1.35084
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
15400	15		0.100049	4.088847
15600	15		0.112791	4.126781
15800	15		0.126070	4.171434
16000	15		0.140013	4.224690
16200	15		0.154784	4.288675
16400	15		0.170605	4.366206
16600	15		0.187786	4.461443
16800	15		0.206774	4.581045
17000	15		0.228277	4.736685
17200	15		0.253535	4.951569
17400	15		0.285121	5.282237
17600	15		0.330540	5.937779

```
ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.   10
Step description:
of Block No.     14  of Schedule No.   17705
Crack Size     c =  0.371020

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No.   10
Step description:
of Block No.     14  of Schedule No.   17721
Crack Size     c =  0.380291
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    -------Modified by FAI-------
                  DATE: 09-APR-99   TIME: 09:34:52
           (computed: NASA/FLAGRO Version 2.03, March 1995.)
           U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W4 SA227 MS, crack in cap WS 99

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    3.0000
Hole Diameter, D   =    0.1990
Hole-Center-to-Edge Dist., B =    0.3500
Poisson s ratio    =    0.32

FLAW SIZE:

a   (init.) =  0.5000E-01
c   (init.) =  0.5000E-01
a/c (init.) =   1.000



MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    6.9000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    6.8300
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    7.3000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    4.6000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                    Block Case No.
From   -   To
   1   -    1                          1
   2   -    2                          2
   3   -    3                          5
   4   -    4                          1
   5   -    5                          3
   6   -    6                          5
   7   -    7                          1
   8   -    8                          3
   9   -    9                          5
  10   -   10                          1
  11   -   11                          3
  12   -   12                          5
  13   -   13                          1
  14   -   14                          4
  15   -   15                          5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :       S0           :       S1          :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :                    :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         1.90 :   0.70:      1.30:    0.70:      1.30:
   2: 1:         0.09 :   0.60:      1.40:    0.60:      1.40:
   3: 1:         0.01 :   0.54:      1.46:    0.54:      1.46:
 S  : M:  NUMBER      :       S3           :       S           :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :                    :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         1.90 :   0.70:      1.30:    0.00:      0.00:
   2: 1:         0.09 :   0.60:      1.40:    0.00:      0.00:
   3: 1:         0.01 :   0.54:      1.46:    0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                         -+-----

BLOCK CASE NO.  2
 S  : M:  NUMBER      :       S0           :       S1          :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :                    :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         0.00 :   1.08:      1.10:    0.99:      1.01:
```

```
  2: 1:      15.09 :    0.87:     1.31:     0.78:     1.22:
  3: 1:       1.52 :    0.66:     1.52:     0.57:     1.43:
  4: 1:       0.23 :    0.44:     1.74:     0.35:     1.65:
  5: 1:       0.05 :    0.22:     1.96:     0.13:     1.87:
  6: 1:       0.01 :    0.01:     2.17:    -0.08:     2.08:
  7: 1:       0.00 :   -0.21:     2.39:    -0.30:     2.30:
  8: 1:       0.00 :   -0.43:     2.61:    -0.52:     2.52:
  9: 1:       0.00 :   -0.64:     2.82:    -0.73:     2.73:
 10: 1:       0.00 :   -0.86:     3.04:    -0.95:     2.95:
S   : M:  NUMBER   :        S3         :        S          :
T   : A:    OF     :                   :                   :
E   : T:  FATIGUE  :                   :                   :
P   : L:  CYCLES   :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-----------:---------:---------:---------:---------:
  1: 1:       0.00 :    0.99:     1.01:     0.00:     0.00:
  2: 1:      15.09 :    0.78:     1.22:     0.00:     0.00:
  3: 1:       1.52 :    0.57:     1.43:     0.00:     0.00:
  4: 1:       0.23 :    0.35:     1.65:     0.00:     0.00:
  5: 1:       0.05 :    0.13:     1.87:     0.00:     0.00:
  6: 1:       0.01 :   -0.08:     2.08:     0.00:     0.00:
  7: 1:       0.00 :   -0.30:     2.30:     0.00:     0.00:
  8: 1:       0.00 :   -0.52:     2.52:     0.00:     0.00:
  9: 1:       0.00 :   -0.73:     2.73:     0.00:     0.00:
 10: 1:       0.00 :   -0.95:     2.95:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
S   : M:  NUMBER   :        S0         :        S1         :
T   : A:    OF     :                   :                   :
E   : T:  FATIGUE  :                   :                   :
P   : L:  CYCLES   :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-----------:---------:---------:---------:---------:
  1: 1:       0.00 :    1.08:     1.10:     0.99:     1.01:
  2: 1:      31.10 :    0.87:     1.31:     0.78:     1.22:
  3: 1:       2.98 :    0.66:     1.52:     0.57:     1.43:
  4: 1:       0.45 :    0.44:     1.74:     0.35:     1.65:
  5: 1:       0.09 :    0.22:     1.96:     0.13:     1.87:
  6: 1:       0.02 :    0.01:     2.17:    -0.08:     2.08:
  7: 1:       0.01 :   -0.21:     2.39:    -0.30:     2.30:
  8: 1:       0.00 :   -0.43:     2.61:    -0.52:     2.52:
  9: 1:       0.00 :   -0.64:     2.82:    -0.73:     2.73:
 10: 1:       0.00 :   -0.86:     3.04:    -0.95:     2.95:
S   : M:  NUMBER   :        S3         :        S          :
T   : A:    OF     :                   :                   :
E   : T:  FATIGUE  :                   :                   :
P   : L:  CYCLES   :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-----------:---------:---------:---------:---------:
  1: 1:       0.00 :    0.99:     1.01:     0.00:     0.00:
  2: 1:      31.10 :    0.78:     1.22:     0.00:     0.00:
  3: 1:       2.98 :    0.57:     1.43:     0.00:     0.00:
  4: 1:       0.45 :    0.35:     1.65:     0.00:     0.00:
  5: 1:       0.09 :    0.13:     1.87:     0.00:     0.00:
  6: 1:       0.02 :   -0.08:     2.08:     0.00:     0.00:
  7: 1:       0.01 :   -0.30:     2.30:     0.00:     0.00:
  8: 1:       0.00 :   -0.52:     2.52:     0.00:     0.00:
  9: 1:       0.00 :   -0.73:     2.73:     0.00:     0.00:
 10: 1:       0.00 :   -0.95:     2.95:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
S   : M:  NUMBER   :        S0         :        S1         :
T   : A:    OF     :                   :                   :
E   : T:  FATIGUE  :                   :                   :
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	0.00	1.08	1.10	0.99	1.01
2	1	24.52	0.87	1.31	0.78	1.22
3	1	2.73	0.66	1.52	0.57	1.43
4	1	0.46	0.44	1.74	0.35	1.65
5	1	0.11	0.22	1.96	0.13	1.87
6	1	0.03	0.01	2.17	-0.08	2.08
7	1	0.01	-0.21	2.39	-0.30	2.30
8	1	0.00	-0.43	2.61	-0.52	2.52
9	1	0.00	-0.64	2.82	-0.73	2.73
10	1	0.00	-0.86	3.04	-0.95	2.95

S	M	NUMBER	S3		S	
T	A	OF				
E	T	FATIGUE				
P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	0.00	0.99	1.01	0.00	0.00
2	1	24.52	0.78	1.22	0.00	0.00
3	1	2.73	0.57	1.43	0.00	0.00
4	1	0.46	0.35	1.65	0.00	0.00
5	1	0.11	0.13	1.87	0.00	0.00
6	1	0.03	-0.08	2.08	0.00	0.00
7	1	0.01	-0.30	2.30	0.00	0.00
8	1	0.00	-0.52	2.52	0.00	0.00
9	1	0.00	-0.73	2.73	0.00	0.00
10	1	0.00	-0.95	2.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

S	M	NUMBER	S0		S1	
T	A	OF				
E	T	FATIGUE				
P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

S	M	NUMBER	S3		S	
T	A	OF				
E	T	FATIGUE				
P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S	M	NUMBER	S0		S1	
T	A	OF				
E	T	FATIGUE	(ksi)		(ksi)	
P	L	CYCLES	(t1)	(t2)	(t1)	(t2)

1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	7.45	7.59	0.00	0.00
2	1	15.09	6.00	9.04	0.00	0.00
3	1	1.52	4.55	10.49	0.00	0.00
4	1	0.23	3.04	12.01	0.00	0.00
5	1	0.05	1.52	13.52	0.00	0.00
6	1	0.01	0.07	14.97	0.00	0.00
7	1	0.00	-1.45	16.49	0.00	0.00
8	1	0.00	-2.97	18.01	0.00	0.00
9	1	0.00	-4.42	19.46	0.00	0.00
10	1	0.00	-5.93	20.98	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	15.09	0.00	0.00	0.00	0.00
3	1	1.52	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.05	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	7.38	7.51	0.00	0.00
2	1	31.10	5.94	8.95	0.00	0.00

3	1	2.98	4.51	10.38	0.00	0.00
4	1	0.45	3.01	11.88	0.00	0.00
5	1	0.09	1.50	13.39	0.00	0.00
6	1	0.02	0.07	14.82	0.00	0.00
7	1	0.01	-1.43	16.32	0.00	0.00
8	1	0.00	-2.94	17.83	0.00	0.00
9	1	0.00	-4.37	19.26	0.00	0.00
10	1	0.00	-5.87	20.76	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi)		S (ksi)	
			(t1)	(t2)	(t1)	(t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	31.10	0.00	0.00	0.00	0.00
3	1	2.98	0.00	0.00	0.00	0.00
4	1	0.45	0.00	0.00	0.00	0.00
5	1	0.09	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi)		S1 (ksi)	
			(t1)	(t2)	(t1)	(t2)
1	1	0.00	7.88	8.03	0.00	0.00
2	1	24.52	6.35	9.56	0.00	0.00
3	1	2.73	4.82	11.10	0.00	0.00
4	1	0.46	3.21	12.70	0.00	0.00
5	1	0.11	1.61	14.31	0.00	0.00
6	1	0.03	0.07	15.84	0.00	0.00
7	1	0.01	-1.53	17.45	0.00	0.00
8	1	0.00	-3.14	19.05	0.00	0.00
9	1	0.00	-4.67	20.59	0.00	0.00
10	1	0.00	-6.28	22.19	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi)		S (ksi)	
			(t1)	(t2)	(t1)	(t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	24.52	0.00	0.00	0.00	0.00
3	1	2.73	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.11	0.00	0.00	0.00	0.00
6	1	0.03	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.28	4.60	4.65	0.00	0.00
2	1	0.44	3.73	4.88	0.00	0.00
3	1	0.22	2.85	5.15	0.00	0.00
4	1	0.06	1.98	5.43	0.00	0.00
5	1	0.00	1.06	5.70	0.00	0.00
6	1	0.00	0.18	5.98	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	0.00	0.00	0.00	0.00
2	1	0.44	0.00	0.00	0.00	0.00
3	1	0.22	0.00	0.00	0.00	0.00
4	1	0.06	0.00	0.00	0.00	0.00
5	1	0.00	0.00	0.00	0.00	0.00
6	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15	0.051952	0.050721	3.843478	3.098789
400	15	0.053953	0.051503	3.865834	3.153659
600	15	0.056007	0.052349	3.888652	3.207732
800	15	0.058115	0.053262	3.912027	3.261136
1000	15	0.060279	0.054244	3.936044	3.314012
1200	15	0.062503	0.055299	3.960778	3.366514
1400	15	0.064789	0.056430	3.986294	3.418803
1600	15	0.067142	0.057642	4.012648	3.471053
1800	15	0.069564	0.058937	4.039893	3.523446
2000	15	0.072061	0.060322	4.068073	3.576174
2200	15	0.074635	0.061801	4.097231	3.629442
2400	15	0.077292	0.063379	4.127402	3.683466
2600	15	0.080037	0.065065	4.158620	3.738477
2800	15	0.082875	0.066866	4.190917	3.794722
3000	15	0.085813	0.068789	4.224323	3.852463
3200	15	0.088855	0.070847	4.258870	3.911986
3400	15	0.092009	0.073050	4.294584	3.973601
3600	15	0.095283	0.075411	4.331487	4.037643
3800	15	0.098682	0.077947	4.369596	4.104479
4000	15	0.102216	0.080676	4.408921	4.174511
4200	15	0.105893	0.083620	4.449453	4.248174
4400	15	0.109722	0.086803	4.491161	4.325941
4600	15	0.113712	0.090256	4.533974	4.408319
4800	15	0.117873	0.094013	4.577759	4.495838
5000	15	0.122214	0.098118	4.622290	4.589035

Transition to 1-d solution, TC03:
a = 0.1250 t = 0.1250

```
at Cycle No.         1.52  of Load Step No.   3
Step description:
of Block No.       2  of Schedule No.    5125
Crack Size:  c =  0.100861     ,  a/c =    1.23933
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
5200	15		0.103950	5.176043
5400	15		0.112751	5.326403
5600	15		0.122798	5.517303
5800	15		0.134679	5.775406
6000	15		0.149610	6.164269
6200	15		0.171080	6.909999

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =    54.73     K ref =     0.000      K cr =    51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.     14  of Schedule No.    6383
Crack Size      c =  0.233541

                  FATIGUE CRACK GROWTH ANALYSIS
                  -------Modified by FAI-------
                DATE: 09-APR-99    TIME: 09:42:38
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 11, PSE-W4 SA227 MS, crack in cap WS 99 (

GEOMETRY
--------
MODEL: TC11-Corner crack in plate or bar (2D)

Plate Thickness, t =    0.1250
  "   Width, W      =    3.0000
Hole Diameter, D    =    0.1990
Hole-Center-to-Edge Dist., B =    0.3500
2ND AREA, AREATC11 =    1.6700
2ND M. INERTIA =    1.1300
2ND C.G. =    1.5000

FLAW SIZE:

c   (init.) =  0.1009

MATERIAL
--------

MATL 1:
        1        2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  : K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p  :  q  :  DKo  :  Rcl :Alpha:Smax/:
:    :          :     :     :     :       :      :     :SIGo :
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC11

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    6.9000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    6.8300
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    7.3000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    4.6000
Scale Factor for Stress S3:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                 Block Case No.
From   -   To
    1   -     1                        1
    2   -     2                        2
    3   -     3                        5
    4   -     4                        1
    5   -     5                        3
    6   -     6                        5
    7   -     7                        1
    8   -     8                        3
    9   -     9                        5
   10   -    10                        1
   11   -    11                        3
   12   -    12                        5
   13   -    13                        1
   14   -    14                        4
   15   -    15                        5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :         S0          :         S3          :
 T  : A:    OF        :                     :                     :
 E  : T:  FATIGUE     :                     :                     :
 P  : L:  CYCLES      :   (t1)  :  (t2)     :   (t1)  :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.90 :    0.70:      1.30:     0.70:      1.30:
   2: 1:        0.09 :    0.60:      1.40:     0.60:      1.40:
   3: 1:        0.01 :    0.54:      1.46:     0.54:      1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	1.08	1.10	0.99	1.01
2	1	15.09	0.87	1.31	0.78	1.22
3	1	1.52	0.66	1.52	0.57	1.43
4	1	0.23	0.44	1.74	0.35	1.65
5	1	0.05	0.22	1.96	0.13	1.87
6	1	0.01	0.01	2.17	-0.08	2.08
7	1	0.00	-0.21	2.39	-0.30	2.30
8	1	0.00	-0.43	2.61	-0.52	2.52
9	1	0.00	-0.64	2.82	-0.73	2.73
10	1	0.00	-0.86	3.04	-0.95	2.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	1.08	1.10	0.99	1.01
2	1	31.10	0.87	1.31	0.78	1.22
3	1	2.98	0.66	1.52	0.57	1.43
4	1	0.45	0.44	1.74	0.35	1.65
5	1	0.09	0.22	1.96	0.13	1.87
6	1	0.02	0.01	2.17	-0.08	2.08
7	1	0.01	-0.21	2.39	-0.30	2.30
8	1	0.00	-0.43	2.61	-0.52	2.52
9	1	0.00	-0.64	2.82	-0.73	2.73
10	1	0.00	-0.86	3.04	-0.95	2.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	1.08	1.10	0.99	1.01
2	1	24.52	0.87	1.31	0.78	1.22
3	1	2.73	0.66	1.52	0.57	1.43
4	1	0.46	0.44	1.74	0.35	1.65
5	1	0.11	0.22	1.96	0.13	1.87
6	1	0.03	0.01	2.17	-0.08	2.08
7	1	0.01	-0.21	2.39	-0.30	2.30
8	1	0.00	-0.43	2.61	-0.52	2.52
9	1	0.00	-0.64	2.82	-0.73	2.73
10	1	0.00	-0.86	3.04	-0.95	2.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

S T E	M A T	NUMBER OF FATIGUE	S0		S3	

P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	0.28	1.00:	1.01:	1.00:	1.01:
2:	1:	0.44	0.81:	1.06:	0.81:	1.06:
3:	1:	0.22	0.62:	1.12:	0.62:	1.12:
4:	1:	0.06	0.43:	1.18:	0.42:	1.18:
5:	1:	0.00	0.23:	1.24:	0.23:	1.24:
6:	1:	0.00	0.04:	1.30:	0.04:	1.30:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	1.90	-0.70:	-1.30:	0.00:	0.00:
2:	1:	0.09	-0.60:	-1.40:	0.00:	0.00:
3:	1:	0.01	-0.54:	-1.46:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.00	7.45:	7.59:	0.00:	0.00:
2:	1:	15.09	6.00:	9.04:	0.00:	0.00:
3:	1:	1.52	4.55:	10.49:	0.00:	0.00:
4:	1:	0.23	3.04:	12.01:	0.00:	0.00:
5:	1:	0.05	1.52:	13.52:	0.00:	0.00:
6:	1:	0.01	0.07:	14.97:	0.00:	0.00:
7:	1:	0.00	-1.45:	16.49:	0.00:	0.00:
8:	1:	0.00	-2.97:	18.01:	0.00:	0.00:
9:	1:	0.00	-4.42:	19.46:	0.00:	0.00:
10:	1:	0.00	-5.93:	20.98:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.00	7.38:	7.51:	0.00:	0.00:
2:	1:	31.10	5.94:	8.95:	0.00:	0.00:
3:	1:	2.98	4.51:	10.38:	0.00:	0.00:

4:	1:	0.45 :	3.01:	11.88:	0.00:	0.00:
5:	1:	0.09 :	1.50:	13.39:	0.00:	0.00:
6:	1:	0.02 :	0.07:	14.82:	0.00:	0.00:
7:	1:	0.01 :	-1.43:	16.32:	0.00:	0.00:
8:	1:	0.00 :	-2.94:	17.83:	0.00:	0.00:
9:	1:	0.00 :	-4.37:	19.26:	0.00:	0.00:
10:	1:	0.00 :	-5.87:	20.76:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.00 :	7.88:	8.03:	0.00:	0.00:
2:	1:	24.52 :	6.35:	9.56:	0.00:	0.00:
3:	1:	2.73 :	4.82:	11.10:	0.00:	0.00:
4:	1:	0.46 :	3.21:	12.70:	0.00:	0.00:
5:	1:	0.11 :	1.61:	14.31:	0.00:	0.00:
6:	1:	0.03 :	0.07:	15.84:	0.00:	0.00:
7:	1:	0.01 :	-1.53:	17.45:	0.00:	0.00:
8:	1:	0.00 :	-3.14:	19.05:	0.00:	0.00:
9:	1:	0.00 :	-4.67:	20.59:	0.00:	0.00:
10:	1:	0.00 :	-6.28:	22.19:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.28 :	4.60:	4.65:	0.00:	0.00:
2:	1:	0.44 :	3.73:	4.88:	0.00:	0.00:
3:	1:	0.22 :	2.85:	5.15:	0.00:	0.00:
4:	1:	0.06 :	1.98:	5.43:	0.00:	0.00:
5:	1:	0.00 :	1.06:	5.70:	0.00:	0.00:
6:	1:	0.00 :	0.18:	5.98:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
100	15		0.104484	5.036357
200	15		0.108272	5.092384

300	15	0.112246	5.153783
400	15	0.116432	5.221603
500	15	0.120865	5.297210
600	15	0.125588	5.382436
700	15	0.130655	5.479809
800	15	0.136144	5.592957
900	15	0.142163	5.727340
1000	15	0.148870	5.891716
1100	15	0.156521	6.101384
1200	15	0.165570	6.386684
1300	15	0.176969	6.821639
1400	15	0.193559	7.683275

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     53.65      K ref =     0.000      K cr =     51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.      14  of Schedule No.    1483
Crack Size       c =  0.235079

                 FATIGUE CRACK GROWTH ANALYSIS
                -------Modified by FAI-------
               DATE: 09-APR-99   TIME: 09:44:32
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC12, PSE-W4 SA227 Main Spar Cap WS99       (Title)

GEOMETRY
--------
MODEL: TC12-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
  "   Width, W     =    3.0000
Additional Area, AREA3 =    1.6700
Add Area cg dist in y, F3 =    0.4280
Add Area cg dist in x, G3 =    1.5000
Add Area Ix, RIX =    0.1300
Add Area Iy, RIY =    1.1130
Moement      , RM =    0.0000

FLAW SIZE:

c   (init.) =  0.4550




MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak  :  Bk  :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :      :      :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
: 1 :0.200D-08:3.700:0.50:1.00: 2.70: 0.70: 5.84: 1.00:

MODEL: TC12

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0:    6.9000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0:    6.8300
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0:    7.3000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0:    4.6000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                     Block Case No.
From   -    To
    1  -     1                          1
    2  -     2                          2
    3  -     3                          5
    4  -     4                          1
    5  -     5                          3
    6  -     6                          5
    7  -     7                          1
    8  -     8                          3
    9  -     9                          5
   10  -    10                          1
   11  -    11                          3
   12  -    12                          5
   13  -    13                          1
   14  -    14                          4
   15  -    15                          5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :        S0          :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :   (t2)    :   (t1) :   (t2)    :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        1.90 :   0.70:     1.30:    -0.30:      0.30:
   2: 1:        0.09 :   0.60:     1.40:    -0.40:      0.40:
```

3	1	0.01	0.54	1.46	-0.46	0.46

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	1.90	-0.30	0.30	0.00	0.00
2	1	0.09	-0.40	0.40	0.00	0.00
3	1	0.01	-0.46	0.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.08	1.10	-0.01	0.01
2	1	15.09	0.87	1.31	-0.22	0.22
3	1	1.52	0.66	1.52	-0.43	0.43
4	1	0.23	0.44	1.74	-0.65	0.65
5	1	0.05	0.22	1.96	-0.87	0.87
6	1	0.01	0.01	2.17	-1.08	1.08
7	1	0.00	-0.21	2.39	-1.30	1.30
8	1	0.00	-0.43	2.61	-1.52	1.52
9	1	0.00	-0.64	2.82	-1.73	1.73
10	1	0.00	-0.86	3.04	-1.95	1.95

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	0.00	-0.01	0.01	0.00	0.00
2	1	15.09	-0.22	0.22	0.00	0.00
3	1	1.52	-0.43	0.43	0.00	0.00
4	1	0.23	-0.65	0.65	0.00	0.00
5	1	0.05	-0.87	0.87	0.00	0.00
6	1	0.01	-1.08	1.08	0.00	0.00
7	1	0.00	-1.30	1.30	0.00	0.00
8	1	0.00	-1.52	1.52	0.00	0.00
9	1	0.00	-1.73	1.73	0.00	0.00
10	1	0.00	-1.95	1.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.08	1.10	-0.01	0.01
2	1	31.10	0.87	1.31	-0.22	0.22
3	1	2.98	0.66	1.52	-0.43	0.43
4	1	0.45	0.44	1.74	-0.65	0.65
5	1	0.09	0.22	1.96	-0.87	0.87
6	1	0.02	0.01	2.17	-1.08	1.08
7	1	0.01	-0.21	2.39	-1.30	1.30
8	1	0.00	-0.43	2.61	-1.52	1.52
9	1	0.00	-0.64	2.82	-1.73	1.73
10	1	0.00	-0.86	3.04	-1.95	1.95

STE	MAT	NUMBER OF FATIGUE	S2	S

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	0.00	-0.01	0.01	0.00	0.00
2:	1:	31.10	-0.22	0.22	0.00	0.00
3:	1:	2.98	-0.43	0.43	0.00	0.00
4:	1:	0.45	-0.65	0.65	0.00	0.00
5:	1:	0.09	-0.87	0.87	0.00	0.00
6:	1:	0.02	-1.08	1.08	0.00	0.00
7:	1:	0.01	-1.30	1.30	0.00	0.00
8:	1:	0.00	-1.52	1.52	0.00	0.00
9:	1:	0.00	-1.73	1.73	0.00	0.00
10:	1:	0.00	-1.95	1.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

S	M:	NUMBER	S0		S1	
T	A:	OF				
E	T:	FATIGUE				
P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	0.00	1.08	1.10	-0.01	0.01
2:	1:	24.52	0.87	1.31	-0.22	0.22
3:	1:	2.73	0.66	1.52	-0.43	0.43
4:	1:	0.46	0.44	1.74	-0.65	0.65
5:	1:	0.11	0.22	1.96	-0.87	0.87
6:	1:	0.03	0.01	2.17	-1.08	1.08
7:	1:	0.01	-0.21	2.39	-1.30	1.30
8:	1:	0.00	-0.43	2.61	-1.52	1.52
9:	1:	0.00	-0.64	2.82	-1.73	1.73
10:	1:	0.00	-0.86	3.04	-1.95	1.95

S	M:	NUMBER	S2		S	
T	A:	OF				
E	T:	FATIGUE				
P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	0.00	-0.01	0.01	0.00	0.00
2:	1:	24.52	-0.22	0.22	0.00	0.00
3:	1:	2.73	-0.43	0.43	0.00	0.00
4:	1:	0.46	-0.65	0.65	0.00	0.00
5:	1:	0.11	-0.87	0.87	0.00	0.00
6:	1:	0.03	-1.08	1.08	0.00	0.00
7:	1:	0.01	-1.30	1.30	0.00	0.00
8:	1:	0.00	-1.52	1.52	0.00	0.00
9:	1:	0.00	-1.73	1.73	0.00	0.00
10:	1:	0.00	-1.95	1.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

S	M:	NUMBER	S0		S1	
T	A:	OF				
E	T:	FATIGUE				
P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	0.28	1.00	1.01	1.00	1.01
2:	1:	0.44	0.81	1.06	0.81	1.06
3:	1:	0.22	0.62	1.12	0.62	1.12
4:	1:	0.06	0.43	1.18	0.42	1.18
5:	1:	0.00	0.23	1.24	0.23	1.24
6:	1:	0.00	0.04	1.30	0.04	1.30

S	M:	NUMBER	S2		S	
T	A:	OF				
E	T:	FATIGUE				
P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)

1:	1:	0.28 :	1.00:	1.00:	0.00:	0.00:
2:	1:	0.44 :	0.81:	1.06:	0.00:	0.00:
3:	1:	0.22 :	0.62:	1.12:	0.00:	0.00:
4:	1:	0.06 :	0.43:	1.18:	0.00:	0.00:
5:	1:	0.00 :	0.23:	1.24:	0.00:	0.00:
6:	1:	0.00 :	0.04:	1.30:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	1.90 :	-0.70:	-1.30:	0.00:	0.00:
2:	1:	0.09 :	-0.60:	-1.40:	0.00:	0.00:
3:	1:	0.01 :	-0.54:	-1.46:	0.00:	0.00:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	1.90 :	0.00:	0.00:	0.00:	0.00:
2:	1:	0.09 :	0.00:	0.00:	0.00:	0.00:
3:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.00 :	7.45:	7.59:	0.00:	0.00:
2:	1:	15.09 :	6.00:	9.04:	0.00:	0.00:
3:	1:	1.52 :	4.55:	10.49:	0.00:	0.00:
4:	1:	0.23 :	3.04:	12.01:	0.00:	0.00:
5:	1:	0.05 :	1.52:	13.52:	0.00:	0.00:
6:	1:	0.01 :	0.07:	14.97:	0.00:	0.00:
7:	1:	0.00 :	-1.45:	16.49:	0.00:	0.00:
8:	1:	0.00 :	-2.97:	18.01:	0.00:	0.00:
9:	1:	0.00 :	-4.42:	19.46:	0.00:	0.00:
10:	1:	0.00 :	-5.93:	20.98:	0.00:	0.00:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
2:	1:	15.09 :	0.00:	0.00:	0.00:	0.00:
3:	1:	1.52 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.23 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.05 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:

7:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
8:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
9:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
10:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.00 :	7.38:	7.51:	0.00:	0.00:
2:	1:	31.10 :	5.94:	8.95:	0.00:	0.00:
3:	1:	2.98 :	4.51:	10.38:	0.00:	0.00:
4:	1:	0.45 :	3.01:	11.88:	0.00:	0.00:
5:	1:	0.09 :	1.50:	13.39:	0.00:	0.00:
6:	1:	0.02 :	0.07:	14.82:	0.00:	0.00:
7:	1:	0.01 :	-1.43:	16.32:	0.00:	0.00:
8:	1:	0.00 :	-2.94:	17.83:	0.00:	0.00:
9:	1:	0.00 :	-4.37:	19.26:	0.00:	0.00:
10:	1:	0.00 :	-5.87:	20.76:	0.00:	0.00:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
2:	1:	31.10 :	0.00:	0.00:	0.00:	0.00:
3:	1:	2.98 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.45 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.09 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.02 :	0.00:	0.00:	0.00:	0.00:
7:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:
8:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
9:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
10:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.00 :	7.88:	8.03:	0.00:	0.00:
2:	1:	24.52 :	6.35:	9.56:	0.00:	0.00:
3:	1:	2.73 :	4.82:	11.10:	0.00:	0.00:
4:	1:	0.46 :	3.21:	12.70:	0.00:	0.00:
5:	1:	0.11 :	1.61:	14.31:	0.00:	0.00:
6:	1:	0.03 :	0.07:	15.84:	0.00:	0.00:
7:	1:	0.01 :	-1.53:	17.45:	0.00:	0.00:
8:	1:	0.00 :	-3.14:	19.05:	0.00:	0.00:
9:	1:	0.00 :	-4.67:	20.59:	0.00:	0.00:
10:	1:	0.00 :	-6.28:	22.19:	0.00:	0.00:

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	24.52	0.00	0.00	0.00	0.00
3	1	2.73	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.11	0.00	0.00	0.00	0.00
6	1	0.03	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.28	4.60	4.65	0.00	0.00
2	1	0.44	3.73	4.88	0.00	0.00
3	1	0.22	2.85	5.15	0.00	0.00
4	1	0.06	1.98	5.43	0.00	0.00
5	1	0.00	1.06	5.70	0.00	0.00
6	1	0.00	0.18	5.98	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	0.00	0.00	0.00	0.00
2	1	0.44	0.00	0.00	0.00	0.00
3	1	0.22	0.00	0.00	0.00	0.00
4	1	0.06	0.00	0.00	0.00	0.00
5	1	0.00	0.00	0.00	0.00	0.00
6	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
100	15		0.481743	8.187519
200	15		0.512666	8.483773
300	15		0.549088	8.831584
400	15		0.593067	9.251762
500	15		0.648085	9.780644
600	15		0.720803	10.490454
700	15		0.826875	11.559870
800	15		1.025862	13.724704

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     51.86      K ref =     0.000      K cr =     51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.      14  of Schedule No.      806
Crack Size       c =    1.04741

                  FATIGUE CRACK GROWTH ANALYSIS
                  -------Modified by FAI-------
                DATE: 09-APR-99   TIME: 09:49:21
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W4 SA227 MS, crack in angle WS 130

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    1.4400
Hole Diameter, D   =    0.1990
Hole-Center-to-Edge Dist., B =    0.3500
Poisson s ratio    =    0.32

FLAW SIZE:

a   (init.) =  0.5000E-01
c   (init.) =  0.5000E-01
a/c (init.) =   1.000



MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:----------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    5.3300
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    2.3000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    5.2800
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    2.2700

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    5.6500
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    2.4300

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.3600
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    1.4500

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
   1   -    1                        1
   2   -    2                        2
   3   -    3                        5
   4   -    4                        1
   5   -    5                        3
   6   -    6                        5
   7   -    7                        1
   8   -    8                        3
   9   -    9                        5
  10   -   10                        1
  11   -   11                        3
  12   -   12                        5
  13   -   13                        1
  14   -   14                        4
  15   -   15                        5

BLOCK CASE NO.  1
 S  : M:  NUMBER     :       S0         :       S1         :
 T  : A:    OF       :                  :                  :
 E  : T:  FATIGUE    :                  :                  :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         1.90 :   0.70:     1.30:    0.70:     1.30:
  2: 1:         0.09 :   0.60:     1.40:    0.60:     1.40:
  3: 1:         0.01 :   0.54:     1.46:    0.54:     1.46:
 S  : M:  NUMBER     :       S3         :       S          :
 T  : A:    OF       :                  :                  :
 E  : T:  FATIGUE    :                  :                  :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         1.90 :   0.70:     1.30:    0.00:     0.00:
  2: 1:         0.09 :   0.60:     1.40:    0.00:     0.00:
  3: 1:         0.01 :   0.54:     1.46:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

BLOCK CASE NO. 2

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.02	1.04	0.99	1.01
2	1	15.09	0.81	1.25	0.78	1.22
3	1	1.52	0.60	1.46	0.57	1.43
4	1	0.23	0.38	1.68	0.35	1.65
5	1	0.05	0.16	1.90	0.13	1.87
6	1	0.01	-0.05	2.11	-0.08	2.08
7	1	0.00	-0.27	2.33	-0.30	2.30
8	1	0.00	-0.49	2.55	-0.52	2.52
9	1	0.00	-0.70	2.76	-0.73	2.73
10	1	0.00	-0.92	2.98	-0.95	2.95

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.00	1.02	1.04	0.00	0.00
2	1	15.09	0.81	1.25	0.00	0.00
3	1	1.52	0.60	1.46	0.00	0.00
4	1	0.23	0.38	1.68	0.00	0.00
5	1	0.05	0.16	1.90	0.00	0.00
6	1	0.01	-0.05	2.11	0.00	0.00
7	1	0.00	-0.27	2.33	0.00	0.00
8	1	0.00	-0.49	2.55	0.00	0.00
9	1	0.00	-0.70	2.76	0.00	0.00
10	1	0.00	-0.92	2.98	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.02	1.04	0.99	1.01
2	1	31.10	0.81	1.25	0.78	1.22
3	1	2.98	0.60	1.46	0.57	1.43
4	1	0.45	0.38	1.68	0.35	1.65
5	1	0.09	0.16	1.90	0.13	1.87
6	1	0.02	-0.05	2.11	-0.08	2.08
7	1	0.01	-0.27	2.33	-0.30	2.30
8	1	0.00	-0.49	2.55	-0.52	2.52
9	1	0.00	-0.70	2.76	-0.73	2.73
10	1	0.00	-0.92	2.98	-0.95	2.95

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.00	1.02	1.04	0.00	0.00
2	1	31.10	0.81	1.25	0.00	0.00
3	1	2.98	0.60	1.46	0.00	0.00
4	1	0.45	0.38	1.68	0.00	0.00
5	1	0.09	0.16	1.90	0.00	0.00
6	1	0.02	-0.05	2.11	0.00	0.00
7	1	0.01	-0.27	2.33	0.00	0.00
8	1	0.00	-0.49	2.55	0.00	0.00
9	1	0.00	-0.70	2.76	0.00	0.00
10	1	0.00	-0.92	2.98	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.02	1.04	0.99	1.01
2	1	24.52	0.81	1.25	0.78	1.22
3	1	2.73	0.60	1.46	0.57	1.43
4	1	0.46	0.38	1.68	0.35	1.65
5	1	0.11	0.16	1.90	0.13	1.87
6	1	0.03	-0.05	2.11	-0.08	2.08
7	1	0.01	-0.27	2.33	-0.30	2.30
8	1	0.00	-0.49	2.55	-0.52	2.52
9	1	0.00	-0.70	2.76	-0.73	2.73
10	1	0.00	-0.92	2.98	-0.95	2.95

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.00	1.02	1.04	0.00	0.00
2	1	24.52	0.81	1.25	0.00	0.00
3	1	2.73	0.60	1.46	0.00	0.00
4	1	0.46	0.38	1.68	0.00	0.00
5	1	0.11	0.16	1.90	0.00	0.00
6	1	0.03	-0.05	2.11	0.00	0.00
7	1	0.01	-0.27	2.33	0.00	0.00
8	1	0.00	-0.49	2.55	0.00	0.00
9	1	0.00	-0.70	2.76	0.00	0.00
10	1	0.00	-0.92	2.98	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	5.44	5.54	0.00	0.00
2	1	15.09	4.32	6.66	0.00	0.00
3	1	1.52	3.20	7.78	0.00	0.00
4	1	0.23	2.03	8.95	0.00	0.00
5	1	0.05	0.85	10.13	0.00	0.00
6	1	0.01	-0.27	11.25	0.00	0.00
7	1	0.00	-1.44	12.42	0.00	0.00
8	1	0.00	-2.61	13.59	0.00	0.00
9	1	0.00	-3.73	14.71	0.00	0.00
10	1	0.00	-4.90	15.88	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	2.35	2.39	0.00	0.00
2	1	15.09	1.86	2.88	0.00	0.00
3	1	1.52	1.38	3.36	0.00	0.00
4	1	0.23	0.87	3.86	0.00	0.00
5	1	0.05	0.37	4.37	0.00	0.00
6	1	0.01	-0.12	4.85	0.00	0.00
7	1	0.00	-0.62	5.36	0.00	0.00
8	1	0.00	-1.13	5.86	0.00	0.00
9	1	0.00	-1.61	6.35	0.00	0.00
10	1	0.00	-2.12	6.85	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	5.39	5.49	0.00	0.00
2	1	31.10	4.28	6.60	0.00	0.00
3	1	2.98	3.17	7.71	0.00	0.00
4	1	0.45	2.01	8.87	0.00	0.00
5	1	0.09	0.84	10.03	0.00	0.00
6	1	0.02	-0.26	11.14	0.00	0.00
7	1	0.01	-1.43	12.30	0.00	0.00
8	1	0.00	-2.59	13.46	0.00	0.00
9	1	0.00	-3.70	14.57	0.00	0.00
10	1	0.00	-4.86	15.73	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	2.32	2.36	0.00	0.00
2	1	31.10	1.84	2.84	0.00	0.00
3	1	2.98	1.36	3.31	0.00	0.00
4	1	0.45	0.86	3.81	0.00	0.00
5	1	0.09	0.36	4.31	0.00	0.00
6	1	0.02	-0.11	4.79	0.00	0.00
7	1	0.01	-0.61	5.29	0.00	0.00
8	1	0.00	-1.11	5.79	0.00	0.00
9	1	0.00	-1.59	6.27	0.00	0.00
10	1	0.00	-2.09	6.76	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	5.76	5.88	0.00	0.00
2	1	24.52	4.58	7.06	0.00	0.00
3	1	2.73	3.39	8.25	0.00	0.00
4	1	0.46	2.15	9.49	0.00	0.00
5	1	0.11	0.90	10.73	0.00	0.00
6	1	0.03	-0.28	11.92	0.00	0.00
7	1	0.01	-1.53	13.16	0.00	0.00
8	1	0.00	-2.77	14.41	0.00	0.00
9	1	0.00	-3.96	15.59	0.00	0.00
10	1	0.00	-5.20	16.84	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	2.48	2.53	0.00	0.00
2	1	24.52	1.97	3.04	0.00	0.00
3	1	2.73	1.46	3.55	0.00	0.00
4	1	0.46	0.92	4.08	0.00	0.00
5	1	0.11	0.39	4.62	0.00	0.00
6	1	0.03	-0.12	5.13	0.00	0.00
7	1	0.01	-0.66	5.66	0.00	0.00
8	1	0.00	-1.19	6.20	0.00	0.00

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

9:	1:	0.00 :	-1.70:	6.71:	0.00:	0.00:
10:	1:	0.00 :	-2.24:	7.24:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28 :	3.36:	3.39:	0.00:	0.00:
2:	1:	0.44 :	2.72:	3.56:	0.00:	0.00:
3:	1:	0.22 :	2.08:	3.76:	0.00:	0.00:
4:	1:	0.06 :	1.44:	3.96:	0.00:	0.00:
5:	1:	0.00 :	0.77:	4.17:	0.00:	0.00:
6:	1:	0.00 :	0.13:	4.37:	0.00:	0.00:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	0.28 :	1.45:	1.45:	0.00:	0.00:
2:	1:	0.44 :	1.17:	1.54:	0.00:	0.00:
3:	1:	0.22 :	0.90:	1.62:	0.00:	0.00:
4:	1:	0.06 :	0.62:	1.71:	0.00:	0.00:
5:	1:	0.00 :	0.33:	1.80:	0.00:	0.00:
6:	1:	0.00 :	0.06:	1.89:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15	0.051282	0.050399	3.338267	2.611330
400	15	0.052582	0.050823	3.349567	2.642877
600	15	0.053903	0.051271	3.360949	2.673991
800	15	0.055244	0.051746	3.372442	2.704697
1000	15	0.056605	0.052246	3.384073	2.735023
1200	15	0.057987	0.052774	3.395869	2.765000
1400	15	0.059391	0.053330	3.407853	2.794660
1600	15	0.060818	0.053913	3.420046	2.824037
1800	15	0.062267	0.054526	3.432468	2.853169
2000	15	0.063739	0.055169	3.445139	2.882091
2200	15	0.065237	0.055842	3.458074	2.910844
2400	15	0.066759	0.056547	3.471288	2.939468
2600	15	0.068307	0.057284	3.484796	2.968005
2800	15	0.069883	0.058055	3.498610	2.996498
3000	15	0.071486	0.058860	3.512742	3.024992
3200	15	0.073119	0.059701	3.527203	3.053532
3400	15	0.074782	0.060578	3.542002	3.082167
3600	15	0.076476	0.061493	3.557150	3.110947
3800	15	0.078202	0.062448	3.572654	3.139920
4000	15	0.079963	0.063443	3.588524	3.169140

4200	15	0.081758	0.064482	3.604768	3.198660
4400	15	0.083590	0.065564	3.621394	3.228537
4600	15	0.085460	0.066693	3.638409	3.258829
4800	15	0.087369	0.067871	3.655822	3.289597
5000	15	0.089319	0.069100	3.673641	3.320906
5200	15	0.091312	0.070382	3.691873	3.352824
5400	15	0.093349	0.071721	3.710526	3.385421
5600	15	0.095432	0.073119	3.729607	3.418771
5800	15	0.097563	0.074580	3.749125	3.452954
6000	15	0.099744	0.076108	3.769086	3.488054
6200	15	0.101977	0.077708	3.789498	3.524158
6400	15	0.104264	0.079382	3.810365	3.561361
6600	15	0.106607	0.081138	3.831694	3.599762
6800	15	0.109009	0.082981	3.853486	3.639467
7000	15	0.111472	0.084916	3.875741	3.680589
7200	15	0.113999	0.086951	3.898454	3.723246
7400	15	0.116592	0.089095	3.921615	3.767562
7600	15	0.119254	0.091355	3.945208	3.813666
7800	15	0.121987	0.093742	3.969205	3.861693
8000	15	0.124795	0.096267	3.993567	3.911778

Transition to 1-d solution, TC03:
a = 0.1250 t = 0.1250
at Cycle No. 2.98 of Load Step No. 3
Step description:
of Block No. 8 of Schedule No. 8015
Crack Size: c = 0.964546E-01 , a/c = 1.29595

Schedl	Block	Step	Final Flaw Size c	K max c-tip
8200	15		0.100053	4.127921
8400	15		0.104105	4.174693
8600	15		0.108361	4.226322
8800	15		0.112854	4.283804
9000	15		0.117622	4.348450
9200	15		0.122717	4.422044
9400	15		0.128208	4.507092
9600	15		0.134190	4.607275
9800	15		0.140801	4.728305
10000	15		0.148250	4.879719
10200	15		0.156892	5.079184
10400	15		0.167405	5.365103
10600	15		0.181428	5.848697
10800	15		0.206269	7.236367

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No. 10
Step description:
of Block No. 14 of Schedule No. 10853
Crack Size c = 0.223020

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No. 10
Step description:
of Block No. 14 of Schedule No. 10863
Crack Size c = 0.230881

FATIGUE CRACK GROWTH ANALYSIS
-------Modified by FAI-------
DATE: 09-APR-99 TIME: 10:10:05
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

THROUGH CRACK CASE 11, PSE-W4 SA227 MS, cracked angle WS130

GEOMETRY

MODEL: TC11-Corner crack in plate or bar (2D)

```
Plate Thickness, t =    0.1250
  "   Width, W     =    1.4440
Hole Diameter, D   =    0.1990
Hole-Center-to-Edge Dist., B =    0.3500
2ND AREA, AREATC11 =    1.3600
2ND M. INERTIA =    0.3700
2ND C.G. =   -0.1700
```

FLAW SIZE:

c   (init.) = 0.9645E-01

MATERIAL

MATL 1:

1   2014T6511 EXTRUSION T-L

Material Properties:

Matl No.	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	74.0	65.0	27.0	27.0	1.00	1.00	0.125	51.8	

Matl No.	Crack Growth Eqn Constants C	n	p	q	DKo	Rcl	Alpha	Smax/SIGo
1	0.200D-08	3.700	0.50	1.00	2.70	0.70	5.84	1.00

MODEL: TC11

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0:   5.3300
Scale Factor for Stress S3:   2.3000

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0:   5.2800
Scale Factor for Stress S3:   2.2700

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0:   5.6500
Scale Factor for Stress S3:   2.4300

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 3.3600
Scale Factor for Stress S3: 1.4500

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	1.02	1.04	1.02	1.04
2	1	15.09	0.81	1.25	0.81	1.25
3	1	1.52	0.60	1.46	0.60	1.46
4	1	0.23	0.38	1.68	0.38	1.68
5	1	0.05	0.16	1.90	0.16	1.90
6	1	0.01	-0.05	2.11	-0.05	2.11
7	1	0.00	-0.27	2.33	-0.27	2.33
8	1	0.00	-0.49	2.55	-0.49	2.55
9	1	0.00	-0.70	2.76	-0.70	2.76
10	1	0.00	-0.92	2.98	-0.92	2.98

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	1.02	1.04	1.02	1.04

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

2:	1:	31.10 :	0.81:	1.25:	0.81:	1.25:
3:	1:	2.98 :	0.60:	1.46:	0.60:	1.46:
4:	1:	0.45 :	0.38:	1.68:	0.38:	1.68:
5:	1:	0.09 :	0.16:	1.90:	0.16:	1.90:
6:	1:	0.02 :	-0.05:	2.11:	-0.05:	2.11:
7:	1:	0.01 :	-0.27:	2.33:	-0.27:	2.33:
8:	1:	0.00 :	-0.49:	2.55:	-0.49:	2.55:
9:	1:	0.00 :	-0.70:	2.76:	-0.70:	2.76:
10:	1:	0.00 :	-0.92:	2.98:	-0.92:	2.98:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	0.00 :	1.02:	1.04:	1.02:	1.04:
2:	1:	24.52 :	0.81:	1.25:	0.81:	1.25:
3:	1:	2.73 :	0.60:	1.46:	0.60:	1.46:
4:	1:	0.46 :	0.38:	1.68:	0.38:	1.68:
5:	1:	0.11 :	0.16:	1.90:	0.16:	1.90:
6:	1:	0.03 :	-0.05:	2.11:	-0.05:	2.11:
7:	1:	0.01 :	-0.27:	2.33:	-0.27:	2.33:
8:	1:	0.00 :	-0.49:	2.55:	-0.49:	2.55:
9:	1:	0.00 :	-0.70:	2.76:	-0.70:	2.76:
10:	1:	0.00 :	-0.92:	2.98:	-0.92:	2.98:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	0.28 :	1.00:	1.01:	1.00:	1.01:
2:	1:	0.44 :	0.81:	1.06:	0.81:	1.06:
3:	1:	0.22 :	0.62:	1.12:	0.62:	1.12:
4:	1:	0.06 :	0.43:	1.18:	0.42:	1.18:
5:	1:	0.00 :	0.23:	1.24:	0.23:	1.24:
6:	1:	0.00 :	0.04:	1.30:	0.04:	1.30:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	1.90 :	-0.70:	-1.30:	-0.70:	-1.30:
2:	1:	0.09 :	-0.60:	-1.40:	-0.60:	-1.40:
3:	1:	0.01 :	-0.54:	-1.46:	-0.54:	-1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.00	5.44	5.54	2.35	2.39
2:	1:	15.09	4.32	6.66	1.86	2.88
3:	1:	1.52	3.20	7.78	1.38	3.36
4:	1:	0.23	2.03	8.95	0.87	3.86
5:	1:	0.05	0.85	10.13	0.37	4.37
6:	1:	0.01	-0.27	11.25	-0.12	4.85
7:	1:	0.00	-1.44	12.42	-0.62	5.36
8:	1:	0.00	-2.61	13.59	-1.13	5.86
9:	1:	0.00	-3.73	14.71	-1.61	6.35
10:	1:	0.00	-4.90	15.88	-2.12	6.85

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.00	5.39	5.49	2.32	2.36
2:	1:	31.10	4.28	6.60	1.84	2.84
3:	1:	2.98	3.17	7.71	1.36	3.31
4:	1:	0.45	2.01	8.87	0.86	3.81
5:	1:	0.09	0.84	10.03	0.36	4.31
6:	1:	0.02	-0.26	11.14	-0.11	4.79
7:	1:	0.01	-1.43	12.30	-0.61	5.29
8:	1:	0.00	-2.59	13.46	-1.11	5.79
9:	1:	0.00	-3.70	14.57	-1.59	6.27
10:	1:	0.00	-4.86	15.73	-2.09	6.76

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.00	5.76	5.88	2.48	2.53
2:	1:	24.52	4.58	7.06	1.97	3.04
3:	1:	2.73	3.39	8.25	1.46	3.55
4:	1:	0.46	2.15	9.49	0.92	4.08
5:	1:	0.11	0.90	10.73	0.39	4.62
6:	1:	0.03	-0.28	11.92	-0.12	5.13
7:	1:	0.01	-1.53	13.16	-0.66	5.66
8:	1:	0.00	-2.77	14.41	-1.19	6.20

9:	1:	0.00 :	-3.96:	15.59:	-1.70:	6.71:
10:	1:	0.00 :	-5.20:	16.84:	-2.24:	7.24:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.28 :	3.36:	3.39:	1.45:	1.46:
2:	1:	0.44 :	2.72:	3.56:	1.17:	1.54:
3:	1:	0.22 :	2.08:	3.76:	0.90:	1.62:
4:	1:	0.06 :	1.44:	3.96:	0.61:	1.71:
5:	1:	0.00 :	0.77:	4.17:	0.33:	1.80:
6:	1:	0.00 :	0.13:	4.37:	0.06:	1.89:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.099420	3.867860
400	15		0.102468	3.892575
600	15		0.105601	3.919081
800	15		0.108829	3.947611
1000	15		0.112159	3.978441
1200	15		0.115605	4.011907
1400	15		0.119179	4.048415
1600	15		0.122898	4.088470
1800	15		0.126781	4.132707
2000	15		0.130853	4.181943
2200	15		0.135143	4.237247
2400	15		0.139691	4.300065
2600	15		0.144549	4.372401
2800	15		0.149784	4.457159
3000	15		0.155496	4.558742
3200	15		0.161831	4.684290
3400	15		0.169027	4.846456
3600	15		0.177506	5.070848
3800	15		0.188183	5.422146
4000	15		0.203936	6.163338

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max = 55.20 K ref = 0.000 K cr = 51.83
at the very beginning of Load Step No. 10
Step description:
of Block No. 11 of Schedule No. 4148
Crack Size c = 0.243579

FATIGUE CRACK GROWTH ANALYSIS
-------Modified by FAI-------
DATE: 09-APR-99 TIME: 10:14:25

```
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC12, PSE-W4 SA227 Main Spar Angle WS130       (Title)

GEOMETRY
--------
MODEL: TC12-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
  "   Width, W     =    1.4400
Additional Area, AREA3 =    1.3600
Add Area cg dist in y, F3 =    0.2940
Add Area cg dist in x, G3 =   -0.1700
Add Area Ix, RIX =    0.1830
Add Area Iy, RIY =    0.3700
Moement      , RM =    0.0000

FLAW SIZE:

c   (init.) =  0.4550

MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p  :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :     :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC12

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    5.3300
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    2.3000

Stress Scaling Factors for Block Case:  3
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
Scale Factor for Stress S0:    5.2800
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    2.2700

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    5.6500
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    2.4300

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.3600
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    1.4500

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
    1   -     1                        1
    2   -     2                        2
    3   -     3                        5
    4   -     4                        1
    5   -     5                        3
    6   -     6                        5
    7   -     7                        1
    8   -     8                        3
    9   -     9                        5
   10   -    10                        1
   11   -    11                        3
   12   -    12                        5
   13   -    13                        1
   14   -    14                        4
   15   -    15                        5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :        S0           :        S1          :
 T   : A:    OF        :                     :                    :
 E   : T:  FATIGUE     :                     :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :   0.70:     1.30:    -0.30:      0.30:
   2: 1:         0.09 :   0.60:     1.40:    -0.40:      0.40:
   3: 1:         0.01 :   0.54:     1.46:    -0.46:      0.46:
 S   : M:  NUMBER      :        S2           :        S           :
 T   : A:    OF        :                     :                    :
 E   : T:  FATIGUE     :                     :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :  -0.30:     0.30:     0.00:      0.00:
   2: 1:         0.09 :  -0.40:     0.40:     0.00:      0.00:
   3: 1:         0.01 :  -0.46:     0.46:     0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S   : M:  NUMBER      :        S0           :        S1          :
 T   : A:    OF        :                     :                    :
 E   : T:  FATIGUE     :                     :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :   1.02:     1.04:    -0.01:      0.01:
   2: 1:        15.09 :   0.81:     1.25:    -0.22:      0.22:
   3: 1:         1.52 :   0.60:     1.46:    -0.43:      0.43:
   4: 1:         0.23 :   0.38:     1.68:    -0.65:      0.65:
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
   5: 1:         0.05 :     0.16:     1.90:    -0.87:     0.87:
   6: 1:         0.01 :    -0.05:     2.11:    -1.08:     1.08:
   7: 1:         0.00 :    -0.27:     2.33:    -1.30:     1.30:
   8: 1:         0.00 :    -0.49:     2.55:    -1.52:     1.52:
   9: 1:         0.00 :    -0.70:     2.76:    -1.73:     1.73:
  10: 1:         0.00 :    -0.92:     2.98:    -1.95:     1.95:
 S  : M:  NUMBER      :        S2          :        S          :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :                    :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :    -0.01:     0.01:     0.00:     0.00:
   2: 1:        15.09 :    -0.22:     0.22:     0.00:     0.00:
   3: 1:         1.52 :    -0.43:     0.43:     0.00:     0.00:
   4: 1:         0.23 :    -0.65:     0.65:     0.00:     0.00:
   5: 1:         0.05 :    -0.87:     0.87:     0.00:     0.00:
   6: 1:         0.01 :    -1.08:     1.08:     0.00:     0.00:
   7: 1:         0.00 :    -1.30:     1.30:     0.00:     0.00:
   8: 1:         0.00 :    -1.52:     1.52:     0.00:     0.00:
   9: 1:         0.00 :    -1.73:     1.73:     0.00:     0.00:
  10: 1:         0.00 :    -1.95:     1.95:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S  : M:  NUMBER      :        S0          :        S1         :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :                    :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :     1.02:     1.04:    -0.01:     0.01:
   2: 1:        31.10 :     0.81:     1.25:    -0.22:     0.22:
   3: 1:         2.98 :     0.60:     1.46:    -0.43:     0.43:
   4: 1:         0.45 :     0.38:     1.68:    -0.65:     0.65:
   5: 1:         0.09 :     0.16:     1.90:    -0.87:     0.87:
   6: 1:         0.02 :    -0.05:     2.11:    -1.08:     1.08:
   7: 1:         0.01 :    -0.27:     2.33:    -1.30:     1.30:
   8: 1:         0.00 :    -0.49:     2.55:    -1.52:     1.52:
   9: 1:         0.00 :    -0.70:     2.76:    -1.73:     1.73:
  10: 1:         0.00 :    -0.92:     2.98:    -1.95:     1.95:
 S  : M:  NUMBER      :        S2          :        S          :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :                    :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :    -0.01:     0.01:     0.00:     0.00:
   2: 1:        31.10 :    -0.22:     0.22:     0.00:     0.00:
   3: 1:         2.98 :    -0.43:     0.43:     0.00:     0.00:
   4: 1:         0.45 :    -0.65:     0.65:     0.00:     0.00:
   5: 1:         0.09 :    -0.87:     0.87:     0.00:     0.00:
   6: 1:         0.02 :    -1.08:     1.08:     0.00:     0.00:
   7: 1:         0.01 :    -1.30:     1.30:     0.00:     0.00:
   8: 1:         0.00 :    -1.52:     1.52:     0.00:     0.00:
   9: 1:         0.00 :    -1.73:     1.73:     0.00:     0.00:
  10: 1:         0.00 :    -1.95:     1.95:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
 S  : M:  NUMBER      :        S0          :        S1         :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :                    :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :     1.02:     1.04:    -0.01:     0.01:
```

2:	1:	24.52 :	0.81:	1.25:	-0.22:	0.22:
3:	1:	2.73 :	0.60:	1.46:	-0.43:	0.43:
4:	1:	0.46 :	0.38:	1.68:	-0.65:	0.65:
5:	1:	0.11 :	0.16:	1.90:	-0.87:	0.87:
6:	1:	0.03 :	-0.05:	2.11:	-1.08:	1.08:
7:	1:	0.01 :	-0.27:	2.33:	-1.30:	1.30:
8:	1:	0.00 :	-0.49:	2.55:	-1.52:	1.52:
9:	1:	0.00 :	-0.70:	2.76:	-1.73:	1.73:
10:	1:	0.00 :	-0.92:	2.98:	-1.95:	1.95:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1:	1:	0.00 :	-0.01:	0.01:	0.00:	0.00:
2:	1:	24.52 :	-0.22:	0.22:	0.00:	0.00:
3:	1:	2.73 :	-0.43:	0.43:	0.00:	0.00:
4:	1:	0.46 :	-0.65:	0.65:	0.00:	0.00:
5:	1:	0.11 :	-0.87:	0.87:	0.00:	0.00:
6:	1:	0.03 :	-1.08:	1.08:	0.00:	0.00:
7:	1:	0.01 :	-1.30:	1.30:	0.00:	0.00:
8:	1:	0.00 :	-1.52:	1.52:	0.00:	0.00:
9:	1:	0.00 :	-1.73:	1.73:	0.00:	0.00:
10:	1:	0.00 :	-1.95:	1.95:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	0.28 :	1.00:	1.01:	1.00:	1.01:
2:	1:	0.44 :	0.81:	1.06:	0.81:	1.06:
3:	1:	0.22 :	0.62:	1.12:	0.62:	1.12:
4:	1:	0.06 :	0.43:	1.18:	0.42:	1.18:
5:	1:	0.00 :	0.23:	1.24:	0.23:	1.24:
6:	1:	0.00 :	0.04:	1.30:	0.04:	1.30:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1:	1:	0.28 :	1.00:	1.00:	0.00:	0.00:
2:	1:	0.44 :	0.81:	1.06:	0.00:	0.00:
3:	1:	0.22 :	0.62:	1.12:	0.00:	0.00:
4:	1:	0.06 :	0.43:	1.18:	0.00:	0.00:
5:	1:	0.00 :	0.23:	1.24:	0.00:	0.00:
6:	1:	0.00 :	0.04:	1.30:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	1.90 :	-0.70:	-1.30:	0.00:	0.00:
2:	1:	0.09 :	-0.60:	-1.40:	0.00:	0.00:

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
  3: 1:         0.01 :   -0.54:    -1.46:     0.00:     0.00:
S  : M: NUMBER       :        S2          :        S          :
T  : A:   OF         :                    :                   :
E  : T: FATIGUE      :      (ksi)         :      (ksi)        :
P  : L: CYCLES       :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         1.90 :    0.00:     0.00:     0.00:     0.00:
  2: 1:         0.09 :    0.00:     0.00:     0.00:     0.00:
  3: 1:         0.01 :    0.00:     0.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S  : M: NUMBER       :        S0          :        S1         :
T  : A:   OF         :                    :                   :
E  : T: FATIGUE      :      (ksi)         :      (ksi)        :
P  : L: CYCLES       :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         0.00 :    5.44:     5.54:     0.00:     0.00:
  2: 1:        15.09 :    4.32:     6.66:     0.00:     0.00:
  3: 1:         1.52 :    3.20:     7.78:     0.00:     0.00:
  4: 1:         0.23 :    2.03:     8.95:     0.00:     0.00:
  5: 1:         0.05 :    0.85:    10.13:     0.00:     0.00:
  6: 1:         0.01 :   -0.27:    11.25:     0.00:     0.00:
  7: 1:         0.00 :   -1.44:    12.42:     0.00:     0.00:
  8: 1:         0.00 :   -2.61:    13.59:     0.00:     0.00:
  9: 1:         0.00 :   -3.73:    14.71:     0.00:     0.00:
 10: 1:         0.00 :   -4.90:    15.88:     0.00:     0.00:
S  : M: NUMBER       :        S2          :        S          :
T  : A:   OF         :                    :                   :
E  : T: FATIGUE      :      (ksi)         :      (ksi)        :
P  : L: CYCLES       :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         0.00 :   -0.02:     0.02:     0.00:     0.00:
  2: 1:        15.09 :   -0.51:     0.51:     0.00:     0.00:
  3: 1:         1.52 :   -0.99:     0.99:     0.00:     0.00:
  4: 1:         0.23 :   -1.49:     1.49:     0.00:     0.00:
  5: 1:         0.05 :   -2.00:     2.00:     0.00:     0.00:
  6: 1:         0.01 :   -2.48:     2.48:     0.00:     0.00:
  7: 1:         0.00 :   -2.99:     2.99:     0.00:     0.00:
  8: 1:         0.00 :   -3.50:     3.50:     0.00:     0.00:
  9: 1:         0.00 :   -3.98:     3.98:     0.00:     0.00:
 10: 1:         0.00 :   -4.48:     4.48:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S  : M: NUMBER       :        S0          :        S1         :
T  : A:   OF         :                    :                   :
E  : T: FATIGUE      :      (ksi)         :      (ksi)        :
P  : L: CYCLES       :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         0.00 :    5.39:     5.49:     0.00:     0.00:
  2: 1:        31.10 :    4.28:     6.60:     0.00:     0.00:
  3: 1:         2.98 :    3.17:     7.71:     0.00:     0.00:
  4: 1:         0.45 :    2.01:     8.87:     0.00:     0.00:
  5: 1:         0.09 :    0.84:    10.03:     0.00:     0.00:
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

6:	1:	0.02 :	-0.26:	11.14:	0.00:	0.00:
7:	1:	0.01 :	-1.43:	12.30:	0.00:	0.00:
8:	1:	0.00 :	-2.59:	13.46:	0.00:	0.00:
9:	1:	0.00 :	-3.70:	14.57:	0.00:	0.00:
10:	1:	0.00 :	-4.86:	15.73:	0.00:	0.00:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	0.00 :	-0.02:	0.02:	0.00:	0.00:
2:	1:	31.10 :	-0.50:	0.50:	0.00:	0.00:
3:	1:	2.98 :	-0.98:	0.98:	0.00:	0.00:
4:	1:	0.45 :	-1.48:	1.48:	0.00:	0.00:
5:	1:	0.09 :	-1.97:	1.97:	0.00:	0.00:
6:	1:	0.02 :	-2.45:	2.45:	0.00:	0.00:
7:	1:	0.01 :	-2.95:	2.95:	0.00:	0.00:
8:	1:	0.00 :	-3.45:	3.45:	0.00:	0.00:
9:	1:	0.00 :	-3.93:	3.93:	0.00:	0.00:
10:	1:	0.00 :	-4.43:	4.43:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.00 :	5.76:	5.88:	0.00:	0.00:
2:	1:	24.52 :	4.58:	7.06:	0.00:	0.00:
3:	1:	2.73 :	3.39:	8.25:	0.00:	0.00:
4:	1:	0.46 :	2.15:	9.49:	0.00:	0.00:
5:	1:	0.11 :	0.90:	10.73:	0.00:	0.00:
6:	1:	0.03 :	-0.28:	11.92:	0.00:	0.00:
7:	1:	0.01 :	-1.53:	13.16:	0.00:	0.00:
8:	1:	0.00 :	-2.77:	14.41:	0.00:	0.00:
9:	1:	0.00 :	-3.96:	15.59:	0.00:	0.00:
10:	1:	0.00 :	-5.20:	16.84:	0.00:	0.00:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	0.00 :	-0.02:	0.02:	0.00:	0.00:
2:	1:	24.52 :	-0.53:	0.53:	0.00:	0.00:
3:	1:	2.73 :	-1.04:	1.04:	0.00:	0.00:
4:	1:	0.46 :	-1.58:	1.58:	0.00:	0.00:
5:	1:	0.11 :	-2.11:	2.11:	0.00:	0.00:
6:	1:	0.03 :	-2.62:	2.62:	0.00:	0.00:
7:	1:	0.01 :	-3.16:	3.16:	0.00:	0.00:
8:	1:	0.00 :	-3.69:	3.69:	0.00:	0.00:
9:	1:	0.00 :	-4.20:	4.20:	0.00:	0.00:
10:	1:	0.00 :	-4.74:	4.74:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
STD
S   : M:  NUMBER       :        S0          :         S1          :
T   : A:    OF         :                    :                     :
E   : T:  FATIGUE      :      (ksi)         :       (ksi)         :
P   : L:  CYCLES       :   (t1) :  (t2)     :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.28 :    3.36:     3.39:     0.00:     0.00:
   2: 1:         0.44 :    2.72:     3.56:     0.00:     0.00:
   3: 1:         0.22 :    2.08:     3.76:     0.00:     0.00:
   4: 1:         0.06 :    1.44:     3.96:     0.00:     0.00:
   5: 1:         0.00 :    0.77:     4.17:     0.00:     0.00:
   6: 1:         0.00 :    0.13:     4.37:     0.00:     0.00:
S   : M:  NUMBER       :        S2          :         S           :
T   : A:    OF         :                    :                     :
E   : T:  FATIGUE      :      (ksi)         :       (ksi)         :
P   : L:  CYCLES       :   (t1) :  (t2)     :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.28 :    1.45:     1.45:     0.00:     0.00:
   2: 1:         0.44 :    1.17:     1.54:     0.00:     0.00:
   3: 1:         0.22 :    0.90:     1.62:     0.00:     0.00:
   4: 1:         0.06 :    0.62:     1.71:     0.00:     0.00:
   5: 1:         0.00 :    0.33:     1.80:     0.00:     0.00:
   6: 1:         0.00 :    0.06:     1.89:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

ANALYSIS RESULTS:
-----------------


 Schedl    Block            Final Flaw Size            K max
                  Step             c                   c-tip
    100      15               0.487895               8.562448
    200      15               0.529924               9.120512
    300      15               0.588075               9.942195
    400      15               0.683526              11.445390

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     51.93     K ref =     0.000     K cr =     51.83
at Cycle No.          0.00  of Load Step No.    10
Step description: ,
of Block No.      14  of Schedule No.     468
Crack Size      c =  0.832454

                 FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
               DATE: 09-APR-99   TIME: 10:17:15
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W4 SA227 MS, crack in angle WS 146

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    1.4400
Hole Diameter, D   =    0.1990
Hole-Center-to-Edge Dist., B =    0.3500
Poisson s ratio    =    0.30
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
FLAW SIZE:

a   (init.) =  0.5000E-01
c   (init.) =  0.5000E-01
a/c (init.) =   1.000



MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    4.4100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    4.1700

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    4.3600
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    4.1300

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    4.6600
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    4.4200

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    2.6900
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    2.5500

Total No. of Blocks in Schedule =    15
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
   Block Number and Case Correspondences
 Block Number                    Block Case No.
From    -   To
    1   -      1                        1
    2   -      2                        2
    3   -      3                        5
    4   -      4                        1
    5   -      5                        3
    6   -      6                        5
    7   -      7                        1
    8   -      8                        3
    9   -      9                        5
   10   -     10                        1
   11   -     11                        3
   12   -     12                        5
   13   -     13                        1
   14   -     14                        4
   15   -     15                        5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :        S0          :         S1          :
 T   : A:    OF        :                    :                     :
 E   : T:  FATIGUE     :                    :                     :
 P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:     0.70:     1.30:
   2: 1:         0.09 :    0.60:     1.40:     0.60:     1.40:
   3: 1:         0.01 :    0.54:     1.46:     0.54:     1.46:
 S   : M:  NUMBER      :        S3          :         S           :
 T   : A:    OF        :                    :                     :
 E   : T:  FATIGUE     :                    :                     :
 P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:     0.00:     0.00:
   2: 1:         0.09 :    0.60:     1.40:     0.00:     0.00:
   3: 1:         0.01 :    0.54:     1.46:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S   : M:  NUMBER      :        S0          :         S1          :
 T   : A:    OF        :                    :                     :
 E   : T:  FATIGUE     :                    :                     :
 P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :    0.99:     1.01:     0.99:     1.01:
   2: 1:        15.09 :    0.78:     1.22:     0.78:     1.22:
   3: 1:         1.52 :    0.57:     1.43:     0.57:     1.43:
   4: 1:         0.23 :    0.35:     1.65:     0.35:     1.65:
   5: 1:         0.05 :    0.13:     1.87:     0.13:     1.87:
   6: 1:         0.01 :   -0.08:     2.08:    -0.08:     2.08:
   7: 1:         0.00 :   -0.30:     2.30:    -0.30:     2.30:
   8: 1:         0.00 :   -0.52:     2.52:    -0.52:     2.52:
   9: 1:         0.00 :   -0.73:     2.73:    -0.73:     2.73:
  10: 1:         0.00 :   -0.95:     2.95:    -0.95:     2.95:
 S   : M:  NUMBER      :        S3          :         S           :
 T   : A:    OF        :                    :                     :
 E   : T:  FATIGUE     :                    :                     :
 P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :    0.99:     1.01:     0.00:     0.00:
   2: 1:        15.09 :    0.78:     1.22:     0.00:     0.00:
   3: 1:         1.52 :    0.57:     1.43:     0.00:     0.00:
   4: 1:         0.23 :    0.35:     1.65:     0.00:     0.00:
   5: 1:         0.05 :    0.13:     1.87:     0.00:     0.00:
   6: 1:         0.01 :   -0.08:     2.08:     0.00:     0.00:
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

7	1	0.00	-0.30	2.30	0.00	0.00
8	1	0.00	-0.52	2.52	0.00	0.00
9	1	0.00	-0.73	2.73	0.00	0.00
10	1	0.00	-0.95	2.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	0.99	1.01	0.99	1.01
2	1	31.10	0.78	1.22	0.78	1.22
3	1	2.98	0.57	1.43	0.57	1.43
4	1	0.45	0.35	1.65	0.35	1.65
5	1	0.09	0.13	1.87	0.13	1.87
6	1	0.02	-0.08	2.08	-0.08	2.08
7	1	0.01	-0.30	2.30	-0.30	2.30
8	1	0.00	-0.52	2.52	-0.52	2.52
9	1	0.00	-0.73	2.73	-0.73	2.73
10	1	0.00	-0.95	2.95	-0.95	2.95

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.00	0.99	1.01	0.00	0.00
2	1	31.10	0.78	1.22	0.00	0.00
3	1	2.98	0.57	1.43	0.00	0.00
4	1	0.45	0.35	1.65	0.00	0.00
5	1	0.09	0.13	1.87	0.00	0.00
6	1	0.02	-0.08	2.08	0.00	0.00
7	1	0.01	-0.30	2.30	0.00	0.00
8	1	0.00	-0.52	2.52	0.00	0.00
9	1	0.00	-0.73	2.73	0.00	0.00
10	1	0.00	-0.95	2.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	0.99	1.01	0.99	1.01
2	1	24.52	0.78	1.22	0.78	1.22
3	1	2.73	0.57	1.43	0.57	1.43
4	1	0.46	0.35	1.65	0.35	1.65
5	1	0.11	0.13	1.87	0.13	1.87
6	1	0.03	-0.08	2.08	-0.08	2.08
7	1	0.01	-0.30	2.30	-0.30	2.30
8	1	0.00	-0.52	2.52	-0.52	2.52
9	1	0.00	-0.73	2.73	-0.73	2.73
10	1	0.00	-0.95	2.95	-0.95	2.95

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.00	0.99	1.01	0.00	0.00
2	1	24.52	0.78	1.22	0.00	0.00
3	1	2.73	0.57	1.43	0.00	0.00

4:	1:	0.46 :	0.35:	1.65:	0.00:	0.00:
5:	1:	0.11 :	0.13:	1.87:	0.00:	0.00:
6:	1:	0.03 :	-0.08:	2.08:	0.00:	0.00:
7:	1:	0.01 :	-0.30:	2.30:	0.00:	0.00:
8:	1:	0.00 :	-0.52:	2.52:	0.00:	0.00:
9:	1:	0.00 :	-0.73:	2.73:	0.00:	0.00:
10:	1:	0.00 :	-0.95:	2.95:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	0.28 :	1.00:	1.01:	1.00:	1.01:
2:	1:	0.44 :	0.81:	1.06:	0.81:	1.06:
3:	1:	0.22 :	0.62:	1.12:	0.62:	1.12:
4:	1:	0.06 :	0.43:	1.18:	0.42:	1.18:
5:	1:	0.00 :	0.23:	1.24:	0.23:	1.24:
6:	1:	0.00 :	0.04:	1.30:	0.04:	1.30:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	0.28 :	1.00:	1.00:	0.00:	0.00:
2:	1:	0.44 :	0.81:	1.06:	0.00:	0.00:
3:	1:	0.22 :	0.62:	1.12:	0.00:	0.00:
4:	1:	0.06 :	0.43:	1.18:	0.00:	0.00:
5:	1:	0.00 :	0.23:	1.24:	0.00:	0.00:
6:	1:	0.00 :	0.04:	1.30:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	1.90 :	-0.70:	-1.30:	0.00:	0.00:
2:	1:	0.09 :	-0.60:	-1.40:	0.00:	0.00:
3:	1:	0.01 :	-0.54:	-1.46:	0.00:	0.00:

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	1.90 :	-0.70:	-1.30:	0.00:	0.00:
2:	1:	0.09 :	-0.60:	-1.40:	0.00:	0.00:
3:	1:	0.01 :	-0.54:	-1.46:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	4.37	4.45	0.00	0.00
2	1	15.09	3.44	5.38	0.00	0.00
3	1	1.52	2.51	6.31	0.00	0.00
4	1	0.23	1.54	7.28	0.00	0.00
5	1	0.05	0.57	8.25	0.00	0.00
6	1	0.01	-0.35	9.17	0.00	0.00
7	1	0.00	-1.32	10.14	0.00	0.00
8	1	0.00	-2.29	11.11	0.00	0.00
9	1	0.00	-3.22	12.04	0.00	0.00
10	1	0.00	-4.19	13.01	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	4.13	4.21	0.00	0.00
2	1	15.09	3.25	5.09	0.00	0.00
3	1	1.52	2.38	5.96	0.00	0.00
4	1	0.23	1.46	6.88	0.00	0.00
5	1	0.05	0.54	7.80	0.00	0.00
6	1	0.01	-0.33	8.67	0.00	0.00
7	1	0.00	-1.25	9.59	0.00	0.00
8	1	0.00	-2.17	10.51	0.00	0.00
9	1	0.00	-3.04	11.38	0.00	0.00
10	1	0.00	-3.96	12.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	4.32	4.40	0.00	0.00
2	1	31.10	3.40	5.32	0.00	0.00
3	1	2.98	2.49	6.23	0.00	0.00
4	1	0.45	1.53	7.19	0.00	0.00
5	1	0.09	0.57	8.15	0.00	0.00
6	1	0.02	-0.35	9.07	0.00	0.00
7	1	0.01	-1.31	10.03	0.00	0.00
8	1	0.00	-2.27	10.99	0.00	0.00
9	1	0.00	-3.18	11.90	0.00	0.00
10	1	0.00	-4.14	12.86	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	4.09	4.17	0.00	0.00
2	1	31.10	3.22	5.04	0.00	0.00
3	1	2.98	2.35	5.91	0.00	0.00
4	1	0.45	1.45	6.81	0.00	0.00
5	1	0.09	0.54	7.72	0.00	0.00
6	1	0.02	-0.33	8.59	0.00	0.00
7	1	0.01	-1.24	9.50	0.00	0.00

8:	1:	0.00	-2.15	10.41	0.00	0.00
9:	1:	0.00	-3.01	11.27	0.00	0.00
10:	1:	0.00	-3.92	12.18	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.00	4.61	4.71	0.00	0.00
2:	1:	24.52	3.63	5.69	0.00	0.00
3:	1:	2.73	2.66	6.66	0.00	0.00
4:	1:	0.46	1.63	7.69	0.00	0.00
5:	1:	0.11	0.61	8.71	0.00	0.00
6:	1:	0.03	-0.37	9.69	0.00	0.00
7:	1:	0.01	-1.40	10.72	0.00	0.00
8:	1:	0.00	-2.42	11.74	0.00	0.00
9:	1:	0.00	-3.40	12.72	0.00	0.00
10:	1:	0.00	-4.43	13.75	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	0.00	4.38	4.46	0.00	0.00
2:	1:	24.52	3.45	5.39	0.00	0.00
3:	1:	2.73	2.52	6.32	0.00	0.00
4:	1:	0.46	1.55	7.29	0.00	0.00
5:	1:	0.11	0.57	8.27	0.00	0.00
6:	1:	0.03	-0.35	9.19	0.00	0.00
7:	1:	0.01	-1.33	10.17	0.00	0.00
8:	1:	0.00	-2.30	11.14	0.00	0.00
9:	1:	0.00	-3.23	12.07	0.00	0.00
10:	1:	0.00	-4.20	13.04	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28	2.69	2.72	0.00	0.00
2:	1:	0.44	2.18	2.85	0.00	0.00
3:	1:	0.22	1.67	3.01	0.00	0.00
4:	1:	0.06	1.16	3.17	0.00	0.00
5:	1:	0.00	0.62	3.34	0.00	0.00
6:	1:	0.00	0.11	3.50	0.00	0.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)

1: 1:	0.28 :	2.55:	2.55:	0.00:	0.00:
2: 1:	0.44 :	2.07:	2.70:	0.00:	0.00:
3: 1:	0.22 :	1.58:	2.86:	0.00:	0.00:
4: 1:	0.06 :	1.10:	3.01:	0.00:	0.00:
5: 1:	0.00 :	0.59:	3.16:	0.00:	0.00:
6: 1:	0.00 :	0.10:	3.31:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block Step	Final Flaw Size a	c	K max a-tip	c-tip
200	15	0.051058	0.050280	3.118919	2.379013
400	15	0.052128	0.050576	3.126410	2.403087
600	15	0.053210	0.050887	3.133893	2.426804
800	15	0.054303	0.051215	3.141384	2.450175
1000	15	0.055408	0.051559	3.148900	2.473213
1200	15	0.056524	0.051919	3.156454	2.495931
1400	15	0.057653	0.052296	3.164062	2.518342
1600	15	0.058794	0.052691	3.171734	2.540462
1800	15	0.059948	0.053102	3.179485	2.562308
2000	15	0.061114	0.053531	3.187323	2.583894
2200	15	0.062293	0.053978	3.195261	2.605240
2400	15	0.063486	0.054443	3.203306	2.626361
2600	15	0.064692	0.054927	3.211468	2.647277
2800	15	0.065912	0.055429	3.219754	2.668006
3000	15	0.067146	0.055950	3.228170	2.688568
3200	15	0.068394	0.056491	3.236723	2.708980
3400	15	0.069658	0.057051	3.245419	2.729264
3600	15	0.070936	0.057632	3.254262	2.749438
3800	15	0.072231	0.058232	3.263257	2.769522
4000	15	0.073541	0.058854	3.272407	2.789538
4200	15	0.074868	0.059497	3.281716	2.809506
4400	15	0.076212	0.060162	3.291187	2.829446
4600	15	0.077574	0.060848	3.300822	2.849380
4800	15	0.078953	0.061558	3.310624	2.869328
5000	15	0.080351	0.062291	3.320594	2.889313
5200	15	0.081767	0.063048	3.330734	2.909356
5400	15	0.083203	0.063829	3.341046	2.929479
5600	15	0.084659	0.064636	3.351530	2.949706
5800	15	0.086136	0.065468	3.362188	2.970058
6000	15	0.087633	0.066327	3.373021	2.990560
6200	15	0.089153	0.067214	3.384028	3.011235
6400	15	0.090694	0.068129	3.395211	3.032107
6600	15	0.092258	0.069073	3.406569	3.053200
6800	15	0.093846	0.070048	3.418103	3.074542
7000	15	0.095458	0.071055	3.429813	3.096156
7200	15	0.097094	0.072093	3.441698	3.118071
7400	15	0.098756	0.073166	3.453758	3.140312
7600	15	0.100444	0.074274	3.465991	3.162909
7800	15	0.102159	0.075419	3.478396	3.185890
8000	15	0.103901	0.076602	3.490973	3.209284
8200	15	0.105671	0.077825	3.503717	3.233122
8400	15	0.107470	0.079089	3.516628	3.257434
8600	15	0.109299	0.080398	3.529700	3.282254
8800	15	0.111157	0.081751	3.542930	3.307613
9000	15	0.113047	0.083153	3.556311	3.333545
9200	15	0.114969	0.084605	3.569837	3.360084
9400	15	0.116924	0.086110	3.583499	3.387265
9600	15	0.118911	0.087670	3.597285	3.415124

9800	15	0.120933	0.089289	3.611183	3.443694
10000	15	0.122990	0.090970	3.625176	3.473010

```
Transition to 1-d solution, TC03:
a =    0.1250       t =   0.1250
at Cycle No.          2.98  of Load Step No.   3
Step description:
of Block No.      5  of Schedule No.   10193
Crack Size:  c =  0.926475E-01 ,  a/c =    1.34920
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
10200	15		0.092743	3.588263
10400	15		0.095226	3.608329
10600	15		0.097770	3.629591
10800	15		0.100380	3.652176
11000	15		0.103061	3.676230
11200	15		0.105820	3.701922
11400	15		0.108664	3.729451
11600	15		0.111601	3.759051
11800	15		0.114641	3.790999
12000	15		0.117796	3.825631
12200	15		0.121080	3.863358
12400	15		0.124508	3.904689
12600	15		0.128100	3.950267
12800	15		0.131881	4.000914
13000	15		0.135881	4.057713
13200	15		0.140140	4.122119
13400	15		0.144709	4.196157
13600	15		0.149659	4.282750
13800	15		0.155090	4.386333
14000	15		0.161151	4.514087
14200	15		0.168083	4.678725
14400	15		0.176320	4.905948
14600	15		0.186800	5.260585
14800	15		0.202494	6.005891

```
ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.   10
Step description:
of Block No.     14  of Schedule No.   14941
Crack Size      c =  0.232283

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No.   10
Step description:
of Block No.     14  of Schedule No.   14947
Crack Size      c =  0.240600

                    FATIGUE CRACK GROWTH ANALYSIS
                   -------Modified by FAI-------
                 DATE: 09-APR-99   TIME: 10:29:19
         (computed: NASA/FLAGRO Version 2.03, March 1995.)
         U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 11, PSE-W4 SA227 MS, cracked angle WS146

GEOMETRY
--------
MODEL: TC11-Corner crack in plate or bar (2D)

Plate Thickness, t =    0.1250
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
  "   Width, W      =    1.4440
Hole Diameter, D   =    0.1990
Hole-Center-to-Edge Dist., B =     0.3500
2ND AREA, AREATC11 =    1.1400
2ND M. INERTIA =    0.3700
2ND C.G. =   -0.1700

FLAW SIZE:

c   (init.) =  0.9260E-01




MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC11

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S3:   -1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    4.4100
Scale Factor for Stress S3:    4.1700

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    4.3600
Scale Factor for Stress S3:    4.1300

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    4.6600
Scale Factor for Stress S3:    4.4200

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    2.6900
Scale Factor for Stress S3:    2.5500

Total No. of Blocks in Schedule =    15
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	0.99	1.01	0.99	1.01
2	1	15.09	0.78	1.22	0.78	1.22
3	1	1.52	0.57	1.43	0.57	1.43
4	1	0.23	0.35	1.65	0.35	1.65
5	1	0.05	0.13	1.87	0.13	1.87
6	1	0.01	-0.08	2.08	-0.08	2.08
7	1	0.00	-0.30	2.30	-0.30	2.30
8	1	0.00	-0.52	2.52	-0.52	2.52
9	1	0.00	-0.73	2.73	-0.73	2.73
10	1	0.00	-0.95	2.95	-0.95	2.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	0.99	1.01	0.99	1.01
2	1	31.10	0.78	1.22	0.78	1.22
3	1	2.98	0.57	1.43	0.57	1.43
4	1	0.45	0.35	1.65	0.35	1.65
5	1	0.09	0.13	1.87	0.13	1.87
6	1	0.02	-0.08	2.08	-0.08	2.08
7	1	0.01	-0.30	2.30	-0.30	2.30
8	1	0.00	-0.52	2.52	-0.52	2.52
9	1	0.00	-0.73	2.73	-0.73	2.73

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

10	1	0.00	-0.95	2.95	-0.95	2.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	0.99	1.01	0.99	1.01
2	1	24.52	0.78	1.22	0.78	1.22
3	1	2.73	0.57	1.43	0.57	1.43
4	1	0.46	0.35	1.65	0.35	1.65
5	1	0.11	0.13	1.87	0.13	1.87
6	1	0.03	-0.08	2.08	-0.08	2.08
7	1	0.01	-0.30	2.30	-0.30	2.30
8	1	0.00	-0.52	2.52	-0.52	2.52
9	1	0.00	-0.73	2.73	-0.73	2.73
10	1	0.00	-0.95	2.95	-0.95	2.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	-0.70	-1.30	-0.70	-1.30
2	1	0.09	-0.60	-1.40	-0.60	-1.40
3	1	0.01	-0.54	-1.46	-0.54	-1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

ST	MA	NUMBER OF	S0	S3

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

E P	T: L:	FATIGUE CYCLES	(ksi) (t1)	(t2)	(ksi) (t1)	(t2)
1:	1:	0.00	4.37:	4.45:	4.13:	4.21:
2:	1:	15.09	3.44:	5.38:	3.25:	5.09:
3:	1:	1.52	2.51:	6.31:	2.38:	5.96:
4:	1:	0.23	1.54:	7.28:	1.46:	6.88:
5:	1:	0.05	0.57:	8.25:	0.54:	7.80:
6:	1:	0.01	-0.35:	9.17:	-0.33:	8.67:
7:	1:	0.00	-1.32:	10.14:	-1.25:	9.59:
8:	1:	0.00	-2.29:	11.11:	-2.17:	10.51:
9:	1:	0.00	-3.22:	12.04:	-3.04:	11.38:
10:	1:	0.00	-4.19:	13.01:	-3.96:	12.30:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (t2)	S3 (ksi) (t1)	S3 (t2)
1:	1:	0.00	4.32:	4.40:	4.09:	4.17:
2:	1:	31.10	3.40:	5.32:	3.22:	5.04:
3:	1:	2.98	2.49:	6.23:	2.35:	5.91:
4:	1:	0.45	1.53:	7.19:	1.45:	6.81:
5:	1:	0.09	0.57:	8.15:	0.54:	7.72:
6:	1:	0.02	-0.35:	9.07:	-0.33:	8.59:
7:	1:	0.01	-1.31:	10.03:	-1.24:	9.50:
8:	1:	0.00	-2.27:	10.99:	-2.15:	10.41:
9:	1:	0.00	-3.18:	11.90:	-3.01:	11.27:
10:	1:	0.00	-4.14:	12.86:	-3.92:	12.18:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (t2)	S3 (ksi) (t1)	S3 (t2)
1:	1:	0.00	4.61:	4.71:	4.38:	4.46:
2:	1:	24.52	3.63:	5.69:	3.45:	5.39:
3:	1:	2.73	2.66:	6.66:	2.52:	6.32:
4:	1:	0.46	1.63:	7.69:	1.55:	7.29:
5:	1:	0.11	0.61:	8.71:	0.57:	8.27:
6:	1:	0.03	-0.37:	9.69:	-0.35:	9.19:
7:	1:	0.01	-1.40:	10.72:	-1.33:	10.17:
8:	1:	0.00	-2.42:	11.74:	-2.30:	11.14:
9:	1:	0.00	-3.40:	12.72:	-3.23:	12.07:
10:	1:	0.00	-4.43:	13.75:	-4.20:	13.04:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	2.69	2.72	2.55	2.58
2	1	0.44	2.18	2.85	2.07	2.70
3	1	0.22	1.67	3.01	1.58	2.86
4	1	0.06	1.16	3.17	1.07	3.01
5	1	0.00	0.62	3.34	0.59	3.16
6	1	0.00	0.11	3.50	0.10	3.31

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 11, PSE-
MODEL: TC11

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.094528	3.396544
400	15		0.096481	3.407428
600	15		0.098462	3.418836
800	15		0.100472	3.430806
1000	15		0.102512	3.443379
1200	15		0.104586	3.456602
1400	15		0.106694	3.470526
1600	15		0.108839	3.485208
1800	15		0.111024	3.500711
2000	15		0.113251	3.517107
2200	15		0.115525	3.534477
2400	15		0.117848	3.552914
2600	15		0.120224	3.572523
2800	15		0.122658	3.593426
3000	15		0.125156	3.615765
3200	15		0.127721	3.639707
3400	15		0.130362	3.665446
3600	15		0.133086	3.693216
3800	15		0.135902	3.723299
4000	15		0.138820	3.756037
4200	15		0.141853	3.791852
4400	15		0.145016	3.831271
4600	15		0.148327	3.874969
4800	15		0.151809	3.923820
5000	15		0.155490	3.978986
5200	15		0.159409	4.042062
5400	15		0.163615	4.115303
5600	15		0.168178	4.202053
5800	15		0.173199	4.307541
6000	15		0.178833	4.440607
6200	15		0.185343	4.617881
6400	15		0.193244	4.876413
6600	15		0.203817	5.328763
6800	15		0.223641	6.856731

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max = 54.29 K ref = 0.000 K cr = 51.83
at the very beginning of Load Step No. 8
Step description:

```
of Block No.     14  of Schedule No.    6847
Crack Size     c =  0.245910

                 FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
               DATE: 09-APR-99   TIME: 10:30:13
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC12, PSE-W4 SA227 Main Spar Angle WS146       (Title)

GEOMETRY
--------
MODEL: TC12-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
  "   Width, W     =    1.4400
Additional Area, AREA3 =    1.1400
Add Area cg dist in y, F3 =    0.2940
Add Area cg dist in x, G3 =   -0.1700
Add Area Ix, RIX =    0.1830
Add Area Iy, RIY =    0.3700
Moement      , RM =    0.0000

FLAW SIZE:

c   (init.) =  0.4550




MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl: UTS :  YS  : K1e : K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: TC12

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  2
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
Scale Factor for Stress S0:    5.5100
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    5.4500
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    5.8300
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.3700
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                    Block Case No.
From   -   To
   1   -    1                          1
   2   -    2                          2
   3   -    3                          5
   4   -    4                          1
   5   -    5                          3
   6   -    6                          5
   7   -    7                          1
   8   -    8                          3
   9   -    9                          5
  10   -   10                          1
  11   -   11                          3
  12   -   12                          5
  13   -   13                          1
  14   -   14                          4
  15   -   15                          5

BLOCK CASE NO.  1
 S  : M:  NUMBER     :        S0         :        S1         :
 T  : A:    OF       :                   :                   :
 E  : T:  FATIGUE    :                   :                   :
 P  : L:  CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         1.90 :   0.70:     1.30:   -0.30:     0.30:
  2: 1:         0.09 :   0.60:     1.40:   -0.40:     0.40:
  3: 1:         0.01 :   0.54:     1.46:   -0.46:     0.46:
 S  : M:  NUMBER     :        S2         :        S          :
 T  : A:    OF       :                   :                   :
 E  : T:  FATIGUE    :                   :                   :
 P  : L:  CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         1.90 :  -0.30:     0.30:    0.00:     0.00:
  2: 1:         0.09 :  -0.40:     0.40:    0.00:     0.00:
  3: 1:         0.01 :  -0.46:     0.46:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER     :        S0         :        S1         :
 T  : A:    OF       :                   :                   :
 E  : T:  FATIGUE    :                   :                   :
```

P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	0.00	0.99	1.01	-0.01	0.01
2	1	15.09	0.78	1.22	-0.22	0.22
3	1	1.52	0.57	1.43	-0.43	0.43
4	1	0.23	0.35	1.65	-0.65	0.65
5	1	0.05	0.13	1.87	-0.87	0.87
6	1	0.01	-0.08	2.08	-1.08	1.08
7	1	0.00	-0.30	2.30	-1.30	1.30
8	1	0.00	-0.52	2.52	-1.52	1.52
9	1	0.00	-0.73	2.73	-1.73	1.73
10	1	0.00	-0.95	2.95	-1.95	1.95

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	0.00	-0.01	0.01	0.00	0.00
2	1	15.09	-0.22	0.22	0.00	0.00
3	1	1.52	-0.43	0.43	0.00	0.00
4	1	0.23	-0.65	0.65	0.00	0.00
5	1	0.05	-0.87	0.87	0.00	0.00
6	1	0.01	-1.08	1.08	0.00	0.00
7	1	0.00	-1.30	1.30	0.00	0.00
8	1	0.00	-1.52	1.52	0.00	0.00
9	1	0.00	-1.73	1.73	0.00	0.00
10	1	0.00	-1.95	1.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	0.99	1.01	-0.01	0.01
2	1	31.10	0.78	1.22	-0.22	0.22
3	1	2.98	0.57	1.43	-0.43	0.43
4	1	0.45	0.35	1.65	-0.65	0.65
5	1	0.09	0.13	1.87	-0.87	0.87
6	1	0.02	-0.08	2.08	-1.08	1.08
7	1	0.01	-0.30	2.30	-1.30	1.30
8	1	0.00	-0.52	2.52	-1.52	1.52
9	1	0.00	-0.73	2.73	-1.73	1.73
10	1	0.00	-0.95	2.95	-1.95	1.95

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	0.00	-0.01	0.01	0.00	0.00
2	1	31.10	-0.22	0.22	0.00	0.00
3	1	2.98	-0.43	0.43	0.00	0.00
4	1	0.45	-0.65	0.65	0.00	0.00
5	1	0.09	-0.87	0.87	0.00	0.00
6	1	0.02	-1.08	1.08	0.00	0.00
7	1	0.01	-1.30	1.30	0.00	0.00
8	1	0.00	-1.52	1.52	0.00	0.00
9	1	0.00	-1.73	1.73	0.00	0.00
10	1	0.00	-1.95	1.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	0.99	1.01	-0.01	0.01
2	1	24.52	0.78	1.22	-0.22	0.22
3	1	2.73	0.57	1.43	-0.43	0.43
4	1	0.46	0.35	1.65	-0.65	0.65
5	1	0.11	0.13	1.87	-0.87	0.87
6	1	0.03	-0.08	2.08	-1.08	1.08
7	1	0.01	-0.30	2.30	-1.30	1.30
8	1	0.00	-0.52	2.52	-1.52	1.52
9	1	0.00	-0.73	2.73	-1.73	1.73
10	1	0.00	-0.95	2.95	-1.95	1.95

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	0.00	-0.01	0.01	0.00	0.00
2	1	24.52	-0.22	0.22	0.00	0.00
3	1	2.73	-0.43	0.43	0.00	0.00
4	1	0.46	-0.65	0.65	0.00	0.00
5	1	0.11	-0.87	0.87	0.00	0.00
6	1	0.03	-1.08	1.08	0.00	0.00
7	1	0.01	-1.30	1.30	0.00	0.00
8	1	0.00	-1.52	1.52	0.00	0.00
9	1	0.00	-1.73	1.73	0.00	0.00
10	1	0.00	-1.95	1.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S	M:	NUMBER	S0	S1

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	-0.70	-1.30	0.00	0.00
2	1	0.09	-0.60	-1.40	0.00	0.00
3	1	0.01	-0.54	-1.46	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	5.45	5.57	0.00	0.00
2	1	15.09	4.30	6.72	0.00	0.00
3	1	1.52	3.14	7.88	0.00	0.00
4	1	0.23	1.93	9.09	0.00	0.00
5	1	0.05	0.72	10.30	0.00	0.00
6	1	0.01	-0.44	11.46	0.00	0.00
7	1	0.00	-1.65	12.67	0.00	0.00
8	1	0.00	-2.87	13.89	0.00	0.00
9	1	0.00	-4.02	15.04	0.00	0.00
10	1	0.00	-5.23	16.25	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	15.09	0.00	0.00	0.00	0.00
3	1	1.52	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.05	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)

1	1	0.00	5.40	5.50	0.00	0.00
2	1	31.10	4.25	6.65	0.00	0.00
3	1	2.98	3.11	7.79	0.00	0.00
4	1	0.45	1.91	8.99	0.00	0.00
5	1	0.09	0.71	10.19	0.00	0.00
6	1	0.02	-0.44	11.34	0.00	0.00
7	1	0.01	-1.64	12.54	0.00	0.00
8	1	0.00	-2.83	13.73	0.00	0.00
9	1	0.00	-3.98	14.88	0.00	0.00
10	1	0.00	-5.18	16.08	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	31.10	0.00	0.00	0.00	0.00
3	1	2.98	0.00	0.00	0.00	0.00
4	1	0.45	0.00	0.00	0.00	0.00
5	1	0.09	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	5.77	5.89	0.00	0.00
2	1	24.52	4.55	7.11	0.00	0.00
3	1	2.73	3.32	8.34	0.00	0.00
4	1	0.46	2.04	9.62	0.00	0.00
5	1	0.11	0.76	10.90	0.00	0.00
6	1	0.03	-0.47	12.13	0.00	0.00
7	1	0.01	-1.75	13.41	0.00	0.00
8	1	0.00	-3.03	14.69	0.00	0.00
9	1	0.00	-4.26	15.92	0.00	0.00
10	1	0.00	-5.54	17.20	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	24.52	0.00	0.00	0.00	0.00
3	1	2.73	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.11	0.00	0.00	0.00	0.00
6	1	0.03	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

```
                  -------
 TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S  : M:  NUMBER      :       S0         :        S1         :
T  : A:    OF        :                  :                   :
E  : T:  FATIGUE     :     (ksi)        :      (ksi)        :
P  : L:  CYCLES      :   (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.28 :   3.37:     3.40:    0.00:     0.00:
   2: 1:        0.44 :   2.73:     3.57:    0.00:     0.00:
   3: 1:        0.22 :   2.09:     3.77:    0.00:     0.00:
   4: 1:        0.06 :   1.45:     3.98:    0.00:     0.00:
   5: 1:        0.00 :   0.78:     4.18:    0.00:     0.00:
   6: 1:        0.00 :   0.13:     4.38:    0.00:     0.00:
S  : M:  NUMBER      :       S2         :        S          :
T  : A:    OF        :                  :                   :
E  : T:  FATIGUE     :     (ksi)        :      (ksi)        :
P  : L:  CYCLES      :   (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.28 :   0.00:     0.00:    0.00:     0.00:
   2: 1:        0.44 :   0.00:     0.00:    0.00:     0.00:
   3: 1:        0.22 :   0.00:     0.00:    0.00:     0.00:
   4: 1:        0.06 :   0.00:     0.00:    0.00:     0.00:
   5: 1:        0.00 :   0.00:     0.00:    0.00:     0.00:
   6: 1:        0.00 :   0.00:     0.00:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                  -------
 TC12, PSE-W4 SA227 Main Spa
MODEL: TC12

ANALYSIS RESULTS:
-----------------


 Schedl    Block            Final Flaw Size            K max
                 Step             c                    c-tip
    100      15               0.469716               6.586328
    200      15               0.486206               6.776246
    300      15               0.504940               6.996713
    400      15               0.526608               7.258325
    500      15               0.552278               7.578088
    600      15               0.583745               7.985788
    700      15               0.624404               8.540782
    800      15               0.682073               9.389782
    900      15               0.784119              11.110741

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =    52.03     K ref =    0.000     K cr =    51.83
at the very beginning of Load Step No.   10
Step description:
of Block No.     14  of Schedule No.     945
Crack Size      c =  0.888050

                  FATIGUE CRACK GROWTH ANALYSIS
                  -------Modified by FAI-------
                DATE: 12-APR-99   TIME: 10:38:24
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
CORNER CRACK CASE 2, PSE-W4 SA227 MS, .005 crack angle WS99

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    1.4400
Hole Diameter, D   =    0.1990
Hole-Center-to-Edge Dist., B =    0.3500
Poisson s ratio    =    0.32

FLAW SIZE:

a   (init.) =  0.5000E-02
c   (init.) =  0.5000E-02
a/c (init.) =   1.000




MATERIAL
--------

MATL 1:
        1       2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    6.9000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    6.8300
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  4
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
Scale Factor for Stress S0:    7.3000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    4.6000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S3:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
    1   -     1                        1
    2   -     2                        2
    3   -     3                        5
    4   -     4                        1
    5   -     5                        3
    6   -     6                        5
    7   -     7                        1
    8   -     8                        3
    9   -     9                        5
   10   -    10                        1
   11   -    11                        3
   12   -    12                        5
   13   -    13                        1
   14   -    14                        4
   15   -    15                        5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :        S0         :        S1         :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :                   :                   :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:    0.70:     1.30:
   2: 1:         0.09 :    0.60:     1.40:    0.60:     1.40:
   3: 1:         0.01 :    0.54:     1.46:    0.54:     1.46:
 S  : M:  NUMBER      :        S3         :        S          :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :                   :                   :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:    0.00:     0.00:
   2: 1:         0.09 :    0.60:     1.40:    0.00:     0.00:
   3: 1:         0.01 :    0.54:     1.46:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER      :        S0         :        S1         :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :                   :                   :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :    1.08:     1.10:    0.99:     1.01:
   2: 1:        15.09 :    0.87:     1.31:    0.78:     1.22:
   3: 1:         1.52 :    0.66:     1.52:    0.57:     1.43:
   4: 1:         0.23 :    0.44:     1.74:    0.35:     1.65:
   5: 1:         0.05 :    0.22:     1.96:    0.13:     1.87:
   6: 1:         0.01 :    0.01:     2.17:   -0.08:     2.08:
   7: 1:         0.00 :   -0.21:     2.39:   -0.30:     2.30:
   8: 1:         0.00 :   -0.43:     2.61:   -0.52:     2.52:
   9: 1:         0.00 :   -0.64:     2.82:   -0.73:     2.73:
  10: 1:         0.00 :   -0.86:     3.04:   -0.95:     2.95:
```

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.00	0.99	1.01	0.00	0.00
2	1	15.09	0.78	1.22	0.00	0.00
3	1	1.52	0.57	1.43	0.00	0.00
4	1	0.23	0.35	1.65	0.00	0.00
5	1	0.05	0.13	1.87	0.00	0.00
6	1	0.01	-0.08	2.08	0.00	0.00
7	1	0.00	-0.30	2.30	0.00	0.00
8	1	0.00	-0.52	2.52	0.00	0.00
9	1	0.00	-0.73	2.73	0.00	0.00
10	1	0.00	-0.95	2.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.08	1.10	0.99	1.01
2	1	31.10	0.87	1.31	0.78	1.22
3	1	2.98	0.66	1.52	0.57	1.43
4	1	0.45	0.44	1.74	0.35	1.65
5	1	0.09	0.22	1.96	0.13	1.87
6	1	0.02	0.01	2.17	-0.08	2.08
7	1	0.01	-0.21	2.39	-0.30	2.30
8	1	0.00	-0.43	2.61	-0.52	2.52
9	1	0.00	-0.64	2.82	-0.73	2.73
10	1	0.00	-0.86	3.04	-0.95	2.95

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.00	0.99	1.01	0.00	0.00
2	1	31.10	0.78	1.22	0.00	0.00
3	1	2.98	0.57	1.43	0.00	0.00
4	1	0.45	0.35	1.65	0.00	0.00
5	1	0.09	0.13	1.87	0.00	0.00
6	1	0.02	-0.08	2.08	0.00	0.00
7	1	0.01	-0.30	2.30	0.00	0.00
8	1	0.00	-0.52	2.52	0.00	0.00
9	1	0.00	-0.73	2.73	0.00	0.00
10	1	0.00	-0.95	2.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.08	1.10	0.99	1.01
2	1	24.52	0.87	1.31	0.78	1.22
3	1	2.73	0.66	1.52	0.57	1.43
4	1	0.46	0.44	1.74	0.35	1.65
5	1	0.11	0.22	1.96	0.13	1.87
6	1	0.03	0.01	2.17	-0.08	2.08
7	1	0.01	-0.21	2.39	-0.30	2.30

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
  8: 1:        0.00 :   -0.43:     2.61:    -0.52:     2.52:
  9: 1:        0.00 :   -0.64:     2.82:    -0.73:     2.73:
 10: 1:        0.00 :   -0.86:     3.04:    -0.95:     2.95:
S   : M:  NUMBER     :       S3          :       S           :
T   : A:    OF       :                   :                   :
E   : T:  FATIGUE    :                   :                   :
P   : L:  CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        0.00 :    0.99:     1.01:     0.00:     0.00:
  2: 1:       24.52 :    0.78:     1.22:     0.00:     0.00:
  3: 1:        2.73 :    0.57:     1.43:     0.00:     0.00:
  4: 1:        0.46 :    0.35:     1.65:     0.00:     0.00:
  5: 1:        0.11 :    0.13:     1.87:     0.00:     0.00:
  6: 1:        0.03 :   -0.08:     2.08:     0.00:     0.00:
  7: 1:        0.01 :   -0.30:     2.30:     0.00:     0.00:
  8: 1:        0.00 :   -0.52:     2.52:     0.00:     0.00:
  9: 1:        0.00 :   -0.73:     2.73:     0.00:     0.00:
 10: 1:        0.00 :   -0.95:     2.95:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  5
S   : M:  NUMBER     :       S0          :       S1          :
T   : A:    OF       :                   :                   :
E   : T:  FATIGUE    :                   :                   :
P   : L:  CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        0.28 :    1.00:     1.01:     1.00:     1.01:
  2: 1:        0.44 :    0.81:     1.06:     0.81:     1.06:
  3: 1:        0.22 :    0.62:     1.12:     0.62:     1.12:
  4: 1:        0.06 :    0.43:     1.18:     0.42:     1.18:
  5: 1:        0.00 :    0.23:     1.24:     0.23:     1.24:
  6: 1:        0.00 :    0.04:     1.30:     0.04:     1.30:
S   : M:  NUMBER     :       S3          :       S           :
T   : A:    OF       :                   :                   :
E   : T:  FATIGUE    :                   :                   :
P   : L:  CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        0.28 :    1.00:     1.00:     0.00:     0.00:
  2: 1:        0.44 :    0.81:     1.06:     0.00:     0.00:
  3: 1:        0.22 :    0.62:     1.12:     0.00:     0.00:
  4: 1:        0.06 :    0.43:     1.18:     0.00:     0.00:
  5: 1:        0.00 :    0.23:     1.24:     0.00:     0.00:
  6: 1:        0.00 :    0.04:     1.30:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

 CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER     :       S0          :       S1          :
T   : A:    OF       :                   :                   :
E   : T:  FATIGUE    :     (ksi)         :     (ksi)         :
P   : L:  CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        1.90 :   -0.70:    -1.30:     0.00:     0.00:
  2: 1:        0.09 :   -0.60:    -1.40:     0.00:     0.00:
  3: 1:        0.01 :   -0.54:    -1.46:     0.00:     0.00:
S   : M:  NUMBER     :       S3          :       S           :
T   : A:    OF       :                   :                   :
E   : T:  FATIGUE    :     (ksi)         :     (ksi)         :
P   : L:  CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
```

1:	1:	1.90 :	0.00:	0.00:	0.00:	0.00:
2:	1:	0.09 :	0.00:	0.00:	0.00:	0.00:
3:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.00 :	7.45:	7.59:	0.00:	0.00:
2:	1:	15.09 :	6.00:	9.04:	0.00:	0.00:
3:	1:	1.52 :	4.55:	10.49:	0.00:	0.00:
4:	1:	0.23 :	3.04:	12.01:	0.00:	0.00:
5:	1:	0.05 :	1.52:	13.52:	0.00:	0.00:
6:	1:	0.01 :	0.07:	14.97:	0.00:	0.00:
7:	1:	0.00 :	-1.45:	16.49:	0.00:	0.00:
8:	1:	0.00 :	-2.97:	18.01:	0.00:	0.00:
9:	1:	0.00 :	-4.42:	19.46:	0.00:	0.00:
10:	1:	0.00 :	-5.93:	20.98:	0.00:	0.00:

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
2:	1:	15.09 :	0.00:	0.00:	0.00:	0.00:
3:	1:	1.52 :	0.00:	0.00:	0.00:	0.00:
4:	1:	0.23 :	0.00:	0.00:	0.00:	0.00:
5:	1:	0.05 :	0.00:	0.00:	0.00:	0.00:
6:	1:	0.01 :	0.00:	0.00:	0.00:	0.00:
7:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
8:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
9:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:
10:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.00 :	7.38:	7.51:	0.00:	0.00:
2:	1:	31.10 :	5.94:	8.95:	0.00:	0.00:
3:	1:	2.98 :	4.51:	10.38:	0.00:	0.00:
4:	1:	0.45 :	3.01:	11.88:	0.00:	0.00:
5:	1:	0.09 :	1.50:	13.39:	0.00:	0.00:
6:	1:	0.02 :	0.07:	14.82:	0.00:	0.00:
7:	1:	0.01 :	-1.43:	16.32:	0.00:	0.00:
8:	1:	0.00 :	-2.94:	17.83:	0.00:	0.00:
9:	1:	0.00 :	-4.37:	19.26:	0.00:	0.00:
10:	1:	0.00 :	-5.87:	20.76:	0.00:	0.00:

S : M: NUMBER : S3 : S :

T E P	A T L	OF FATIGUE CYCLES	(ksi) (t1)	(t2)	(ksi) (t1)	(t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	31.10	0.00	0.00	0.00	0.00
3	1	2.98	0.00	0.00	0.00	0.00
4	1	0.45	0.00	0.00	0.00	0.00
5	1	0.09	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	7.88	8.03	0.00	0.00
2	1	24.52	6.35	9.56	0.00	0.00
3	1	2.73	4.82	11.10	0.00	0.00
4	1	0.46	3.21	12.70	0.00	0.00
5	1	0.11	1.61	14.31	0.00	0.00
6	1	0.03	0.07	15.84	0.00	0.00
7	1	0.01	-1.53	17.45	0.00	0.00
8	1	0.00	-3.14	19.05	0.00	0.00
9	1	0.00	-4.67	20.59	0.00	0.00
10	1	0.00	-6.28	22.19	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	24.52	0.00	0.00	0.00	0.00
3	1	2.73	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.11	0.00	0.00	0.00	0.00
6	1	0.03	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

1	1	0.28	4.60	4.65	0.00	0.00
2	1	0.44	3.73	4.88	0.00	0.00
3	1	0.22	2.85	5.15	0.00	0.00
4	1	0.06	1.98	5.43	0.00	0.00
5	1	0.00	1.06	5.70	0.00	0.00
6	1	0.00	0.18	5.98	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	0.00	0.00	0.00	0.00
2	1	0.44	0.00	0.00	0.00	0.00
3	1	0.22	0.00	0.00	0.00	0.00
4	1	0.06	0.00	0.00	0.00	0.00
5	1	0.00	0.00	0.00	0.00	0.00
6	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block	Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15		0.005018	0.005014	1.465869	1.430230
400	15		0.005036	0.005028	1.467932	1.432577
600	15		0.005054	0.005042	1.470009	1.434938
800	15		0.005072	0.005056	1.472102	1.437313
1000	15		0.005090	0.005071	1.474211	1.439703
1200	15		0.005109	0.005085	1.476334	1.442107
1400	15		0.005127	0.005100	1.478476	1.444525
1600	15		0.005146	0.005115	1.480666	1.446948
1800	15		0.005165	0.005130	1.482892	1.449380
2000	15		0.005184	0.005146	1.485147	1.451824
2200	15		0.005203	0.005162	1.487430	1.454280
2400	15		0.005223	0.005178	1.489739	1.456749
2600	15		0.005242	0.005194	1.492074	1.459231
2800	15		0.005262	0.005210	1.494433	1.461727
3000	15		0.005282	0.005227	1.496817	1.464238
3200	15		0.005303	0.005244	1.499224	1.466762
3400	15		0.005323	0.005261	1.501656	1.469301
3600	15		0.005344	0.005279	1.504110	1.471855
3800	15		0.005364	0.005296	1.506589	1.474425
4000	15		0.005385	0.005314	1.509090	1.477009
4200	15		0.005406	0.005332	1.511615	1.479610
4400	15		0.005428	0.005350	1.514163	1.482226
4600	15		0.005449	0.005369	1.516734	1.484859
4800	15		0.005471	0.005387	1.519329	1.487507
5000	15		0.005493	0.005406	1.521947	1.490172
5200	15		0.005515	0.005425	1.524588	1.492854
5400	15		0.005538	0.005444	1.527253	1.495553
5600	15		0.005560	0.005464	1.529941	1.498269
5800	15		0.005583	0.005483	1.532653	1.501003
6000	15		0.005606	0.005503	1.535388	1.503754
6200	15		0.005630	0.005523	1.538148	1.506523
6400	15		0.005653	0.005544	1.540931	1.509309
6600	15		0.005677	0.005564	1.543738	1.512114
6800	15		0.005701	0.005585	1.546570	1.514938
7000	15		0.005725	0.005606	1.549425	1.517780
7200	15		0.005750	0.005627	1.552306	1.520641
7400	15		0.005774	0.005649	1.555211	1.523520

```
FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No.          0.00  of Load Step No.   6
Step description:
of Block No.     15  of Schedule No.    7414
Crack Sizes:  a =  0.577605E-02  , c =  0.565044E-02 ,  a/c =   1.0222

                    FATIGUE CRACK GROWTH ANALYSIS
                   -------Modified by FAI-------
                  DATE: 12-APR-99   TIME: 10:42:58
         (computed: NASA/FLAGRO Version 2.03, March 1995.)
         U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CORNER CRACK CASE 2, PSE-W4 SA227 MS, cont .005 crack angle

GEOMETRY
--------
MODEL: CC02-Corner crack from hole in plate (2D)

Plate Thickness, t =    0.1250
Plate Width, W     =    1.4400
Hole Diameter, D   =    0.1990
Hole-Center-to-Edge Dist., B =    0.3500
Poisson s ratio    =    0.32

FLAW SIZE:

a   (init.) =  0.5650E-02
c   (init.) =  0.5528E-02
a/c (init.) =   1.022


MATERIAL
--------

MATL 1:
        1        2014T6511 EXTRUSION T-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  27.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-08:3.700:0.50:1.00:  2.70:  0.70: 5.84: 1.00:

MODEL: CC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.0000
Scale Factor for Stress S1:    0.0000
```

Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 8.6300
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 8.5400
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 9.1300
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 5.7500
Scale Factor for Stress S1: 0.0000
Scale Factor for Stress S3: 0.0000

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	1.90	0.70:	1.30:	0.70:	1.30:
2:	1:	0.09	0.60:	1.40:	0.60:	1.40:
3:	1:	0.01	0.54:	1.46:	0.54:	1.46:

STEP	MAT:	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1:	1:	1.90	0.70:	1.30:	0.00:	0.00:
2:	1:	0.09	0.60:	1.40:	0.00:	0.00:
3:	1:	0.01	0.54:	1.46:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.08	1.10	0.99	1.01
2	1	15.09	0.87	1.31	0.78	1.22
3	1	1.52	0.66	1.52	0.57	1.43
4	1	0.23	0.44	1.74	0.35	1.65
5	1	0.05	0.22	1.96	0.13	1.87
6	1	0.01	0.01	2.17	-0.08	2.08
7	1	0.00	-0.21	2.39	-0.30	2.30
8	1	0.00	-0.43	2.61	-0.52	2.52
9	1	0.00	-0.64	2.82	-0.73	2.73
10	1	0.00	-0.86	3.04	-0.95	2.95

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.00	0.99	1.01	0.00	0.00
2	1	15.09	0.78	1.22	0.00	0.00
3	1	1.52	0.57	1.43	0.00	0.00
4	1	0.23	0.35	1.65	0.00	0.00
5	1	0.05	0.13	1.87	0.00	0.00
6	1	0.01	-0.08	2.08	0.00	0.00
7	1	0.00	-0.30	2.30	0.00	0.00
8	1	0.00	-0.52	2.52	0.00	0.00
9	1	0.00	-0.73	2.73	0.00	0.00
10	1	0.00	-0.95	2.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.08	1.10	0.99	1.01
2	1	31.10	0.87	1.31	0.78	1.22
3	1	2.98	0.66	1.52	0.57	1.43
4	1	0.45	0.44	1.74	0.35	1.65
5	1	0.09	0.22	1.96	0.13	1.87
6	1	0.02	0.01	2.17	-0.08	2.08
7	1	0.01	-0.21	2.39	-0.30	2.30
8	1	0.00	-0.43	2.61	-0.52	2.52
9	1	0.00	-0.64	2.82	-0.73	2.73
10	1	0.00	-0.86	3.04	-0.95	2.95

STEP	MATL	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.00	0.99	1.01	0.00	0.00
2	1	31.10	0.78	1.22	0.00	0.00
3	1	2.98	0.57	1.43	0.00	0.00
4	1	0.45	0.35	1.65	0.00	0.00
5	1	0.09	0.13	1.87	0.00	0.00
6	1	0.02	-0.08	2.08	0.00	0.00
7	1	0.01	-0.30	2.30	0.00	0.00
8	1	0.00	-0.52	2.52	0.00	0.00
9	1	0.00	-0.73	2.73	0.00	0.00
10	1	0.00	-0.95	2.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.08	1.10	0.99	1.01
2	1	24.52	0.87	1.31	0.78	1.22
3	1	2.73	0.66	1.52	0.57	1.43
4	1	0.46	0.44	1.74	0.35	1.65
5	1	0.11	0.22	1.96	0.13	1.87
6	1	0.03	0.01	2.17	-0.08	2.08
7	1	0.01	-0.21	2.39	-0.30	2.30
8	1	0.00	-0.43	2.61	-0.52	2.52
9	1	0.00	-0.64	2.82	-0.73	2.73
10	1	0.00	-0.86	3.04	-0.95	2.95

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.00	0.99	1.01	0.00	0.00
2	1	24.52	0.78	1.22	0.00	0.00
3	1	2.73	0.57	1.43	0.00	0.00
4	1	0.46	0.35	1.65	0.00	0.00
5	1	0.11	0.13	1.87	0.00	0.00
6	1	0.03	-0.08	2.08	0.00	0.00
7	1	0.01	-0.30	2.30	0.00	0.00
8	1	0.00	-0.52	2.52	0.00	0.00
9	1	0.00	-0.73	2.73	0.00	0.00
10	1	0.00	-0.95	2.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (t1)	S3 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
FATIGUE SCHEDULE BLOCK STRESS TABLE
----------------------------------
STD
 S   : M:  NUMBER      :        S0          :        S1          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :      (ksi)         :      (ksi)         :
 P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :   -0.70:    -1.30:     0.00:     0.00:
   2: 1:         0.09 :   -0.60:    -1.40:     0.00:     0.00:
   3: 1:         0.01 :   -0.54:    -1.46:     0.00:     0.00:
 S   : M:  NUMBER      :        S3          :        S           :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :      (ksi)         :      (ksi)         :
 P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.00:     0.00:     0.00:     0.00:
   2: 1:         0.09 :    0.00:     0.00:     0.00:     0.00:
   3: 1:         0.01 :    0.00:     0.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
----------------------------------
STD
 S   : M:  NUMBER      :        S0          :        S1          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :      (ksi)         :      (ksi)         :
 P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :    9.32:     9.49:     0.00:     0.00:
   2: 1:        15.09 :    7.51:    11.31:     0.00:     0.00:
   3: 1:         1.52 :    5.70:    13.12:     0.00:     0.00:
   4: 1:         0.23 :    3.80:    15.02:     0.00:     0.00:
   5: 1:         0.05 :    1.90:    16.91:     0.00:     0.00:
   6: 1:         0.01 :    0.09:    18.73:     0.00:     0.00:
   7: 1:         0.00 :   -1.81:    20.63:     0.00:     0.00:
   8: 1:         0.00 :   -3.71:    22.52:     0.00:     0.00:
   9: 1:         0.00 :   -5.52:    24.34:     0.00:     0.00:
  10: 1:         0.00 :   -7.42:    26.24:     0.00:     0.00:
 S   : M:  NUMBER      :        S3          :        S           :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :      (ksi)         :      (ksi)         :
 P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:
   2: 1:        15.09 :    0.00:     0.00:     0.00:     0.00:
   3: 1:         1.52 :    0.00:     0.00:     0.00:     0.00:
   4: 1:         0.23 :    0.00:     0.00:     0.00:     0.00:
   5: 1:         0.05 :    0.00:     0.00:     0.00:     0.00:
   6: 1:         0.01 :    0.00:     0.00:     0.00:     0.00:
   7: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:
   8: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:
   9: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:
  10: 1:         0.00 :    0.00:     0.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
----------------------------------
STD
```

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	9.22	9.39	0.00	0.00
2	1	31.10	7.43	11.19	0.00	0.00
3	1	2.98	5.64	12.98	0.00	0.00
4	1	0.45	3.76	14.86	0.00	0.00
5	1	0.09	1.88	16.74	0.00	0.00
6	1	0.02	0.09	18.53	0.00	0.00
7	1	0.01	-1.79	20.41	0.00	0.00
8	1	0.00	-3.67	22.29	0.00	0.00
9	1	0.00	-5.47	24.08	0.00	0.00
10	1	0.00	-7.34	25.96	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	31.10	0.00	0.00	0.00	0.00
3	1	2.98	0.00	0.00	0.00	0.00
4	1	0.45	0.00	0.00	0.00	0.00
5	1	0.09	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	9.86	10.04	0.00	0.00
2	1	24.52	7.94	11.96	0.00	0.00
3	1	2.73	6.03	13.88	0.00	0.00
4	1	0.46	4.02	15.89	0.00	0.00
5	1	0.11	2.01	17.89	0.00	0.00
6	1	0.03	0.09	19.81	0.00	0.00
7	1	0.01	-1.92	21.82	0.00	0.00
8	1	0.00	-3.93	23.83	0.00	0.00
9	1	0.00	-5.84	25.75	0.00	0.00
10	1	0.00	-7.85	27.76	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	24.52	0.00	0.00	0.00	0.00
3	1	2.73	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.11	0.00	0.00	0.00	0.00
6	1	0.03	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00

10:	1:	0.00 :	0.00:	0.00:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28	5.75	5.81	0.00	0.00
2:	1:	0.44	4.66	6.10	0.00	0.00
3:	1:	0.22	3.56	6.44	0.00	0.00
4:	1:	0.06	2.47	6.78	0.00	0.00
5:	1:	0.00	1.32	7.13	0.00	0.00
6:	1:	0.00	0.23	7.48	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	0.28	0.00	0.00	0.00	0.00
2:	1:	0.44	0.00	0.00	0.00	0.00
3:	1:	0.22	0.00	0.00	0.00	0.00
4:	1:	0.06	0.00	0.00	0.00	0.00
5:	1:	0.00	0.00	0.00	0.00	0.00
6:	1:	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CORNER CRACK CASE 2, PSE-W4
MODEL: CC02

ANALYSIS RESULTS:

Schdl	Block	Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
200	15		0.005745	0.005614	1.938364	1.900563
400	15		0.005844	0.005703	1.953254	1.914755
600	15		0.005946	0.005795	1.968540	1.929285
800	15		0.006052	0.005890	1.984235	1.944166
1000	15		0.006163	0.005989	2.000356	1.959410
1200	15		0.006277	0.006092	2.016917	1.975032
1400	15		0.006396	0.006198	2.033938	1.991046
1600	15		0.006519	0.006309	2.051434	2.007468
1800	15		0.006648	0.006424	2.069426	2.024313
2000	15		0.006782	0.006543	2.087934	2.041599
2200	15		0.006921	0.006668	2.106978	2.059342
2400	15		0.007067	0.006797	2.126582	2.077562
2600	15		0.007219	0.006932	2.146767	2.096278
2800	15		0.007377	0.007072	2.167560	2.115510
3000	15		0.007543	0.007219	2.188987	2.135280
3200	15		0.007716	0.007372	2.211075	2.155610
3400	15		0.007898	0.007532	2.233853	2.176524
3600	15		0.008088	0.007699	2.257353	2.198047
3800	15		0.008287	0.007874	2.281608	2.220206
4000	15		0.008497	0.008057	2.306651	2.243027
4200	15		0.008717	0.008249	2.332519	2.266540

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

4400	15	0.008948	0.008450	2.359251	2.290775
4600	15	0.009192	0.008661	2.386889	2.315765
4800	15	0.009448	0.008882	2.415474	2.341543
5000	15	0.009719	0.009115	2.445054	2.368144
5200	15	0.010005	0.009361	2.475676	2.395606
5400	15	0.010308	0.009619	2.507392	2.423968
5600	15	0.010628	0.009891	2.540255	2.453272
5800	15	0.010967	0.010179	2.574323	2.483561
6000	15	0.011328	0.010483	2.609656	2.514880
6200	15	0.011711	0.010804	2.646318	2.547278
6400	15	0.012118	0.011145	2.684376	2.580804
6600	15	0.012552	0.011506	2.723901	2.615512
6800	15	0.013016	0.011889	2.764967	2.651455
7000	15	0.013511	0.012296	2.807654	2.688693
7200	15	0.014041	0.012729	2.852042	2.727286
7400	15	0.014609	0.013191	2.898218	2.767297
7600	15	0.015220	0.013683	2.946271	2.808792
7800	15	0.015876	0.014210	2.996296	2.851843
8000	15	0.016582	0.014773	3.048390	2.896522
8200	15	0.017345	0.015376	3.102654	2.942905
8400	15	0.018169	0.016023	3.159192	2.991071
8600	15	0.019061	0.016718	3.218113	3.041106
8800	15	0.020029	0.017466	3.279526	3.093097
9000	15	0.021081	0.018272	3.343544	3.147146
9200	15	0.022226	0.019142	3.410282	3.203355
9400	15	0.023475	0.020082	3.479855	3.261832
9600	15	0.024839	0.021101	3.552379	3.322696
9800	15	0.026333	0.022206	3.627976	3.386082
10000	15	0.027971	0.023406	3.706768	3.452146

MODEL: CC02

ANALYSIS RESULTS (contd.)

Schdl	Block	Step	Final Flaw Size a	c	K max a-tip	c-tip
10200	15		0.029770	0.024714	3.788873	3.521066
10400	15		0.031751	0.026140	3.874414	3.593046
10600	15		0.033934	0.027699	3.963517	3.668336
10800	15		0.036347	0.029407	4.056326	3.747239
11000	15		0.039016	0.031283	4.152995	3.830133
11200	15		0.041976	0.033349	4.253698	3.917503
11400	15		0.045263	0.035632	4.358649	4.009967
11600	15		0.048921	0.038164	4.468119	4.108327
11800	15		0.053001	0.040984	4.582461	4.213638
12000	15		0.057561	0.044142	4.702151	4.327299
12200	15		0.062671	0.047700	4.827832	4.451195
12400	15		0.068415	0.051743	4.960396	4.587899
12600	15		0.074897	0.056384	5.101080	4.740987
12800	15		0.082245	0.061781	5.251617	4.915539
13000	15		0.090625	0.068168	5.414441	5.118961
13200	15		0.100260	0.075906	5.592935	5.362390
13400	15		0.111452	0.085584	5.791596	5.663149
13600	15		0.124625	0.098250	6.015241	6.048763

Transition to 1-d solution, TC03:
a = 0.1250 t = 0.1250
at Cycle No. 2.98 of Load Step No. 3
Step description:
of Block No. 5 of Schedule No. 13606
Crack Size: c = 0.986379E-01 , a/c = 1.26728

Schedl	Block	Step	Final Flaw Size c	K max c-tip
13800	15		0.121893	6.934713
14000	15		0.160766	8.219127

C-4 PSE W4 SA227 Main Spar Lower Cap at WS 99 (Continued)

```
ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.   10
Step description:
of Block No.     14  of Schedule No.   14004
Crack Size     c =  0.161950

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No.   10
Step description:
of Block No.     14  of Schedule No.   14041
Crack Size     c =  0.174923
```

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    -----------------------------
                  DATE: 09/30/98     TIME: 07:56:18
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]

 PROBLEM TITLE
 -------------
 TC5, PSE-W5 crack in .032 skin, outboard sta99

 GEOMETRY
 --------
 MODEL: TC05-Through crack from hole in row of holes.

 Plate Thickness, t =     0.0320
 Hole Dia., D       =     0.1300
 Hole-to-Hole Dist., H       =     0.8000
 Dia./Edge-Dist. Ratio, D/B =     0.0000
 (D/B = 0 means B is very large)

 FLAW SIZE:

 c   (init.) =  0.5000E-01




 MATERIAL
 --------

 MATL 1: 2024-T3
         Clad Plt & Sht; T-L; LA & HHA

 Material Properties:

 :Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
 : No.:      :      :      :      :     :     :       :      :      :
 :----:------:------:------:------:-----:-----:-------:------:------:
 :  1 :  65.0:  48.0:  41.0:  29.0: 1.00: 1.00:  0.032:  58.0:      :

 :Matl:---------- Crack Growth Eqn Constants -------------:
 : No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
 :    :          :     :    :    :      :      :     :SIGo :
 :----:----------:-----:----:----:------:------:-----:-----:
 :  1 :0.244E-07:2.601:0.50:1.00:  2.90:  0.70: 1.50: 0.30:
  TC5, PSE-W5 crack in .032 skin, outboard sta99
 MODEL: TC05

 FATIGUE SCHEDULE BLOCK INPUT TABLE
 ---------------------------------
 STD

 [Note: Stress = Input Value * Stress Factor]

 Stress Scaling Factors for Block Case:  1

 Scale Factor for Stress S0:    0.00000
 Scale Factor for Stress S3:    0.00000
 Scale Factor for Stress S4:    0.00000

 Stress Scaling Factors for Block Case:  2

 Scale Factor for Stress S0:     5.5000
 Scale Factor for Stress S3:     11.200
 Scale Factor for Stress S4:    0.00000
```

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

```
Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:     5.1000
Scale Factor for Stress S3:     10.400
Scale Factor for Stress S4:    0.00000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:     5.2000
Scale Factor for Stress S3:     10.500
Scale Factor for Stress S4:    0.00000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:     3.5000
Scale Factor for Stress S3:     7.0000
Scale Factor for Stress S4:    0.00000

Total No. of Blocks in Schedule =     15

   Block Number and Case Correspondences
 Block Number                    Block Case No.
From    -    To
    1   -      1                        1
    2   -      2                        2
    3   -      3                        5
    4   -      4                        1
    5   -      5                        3
    6   -      6                        5
    7   -      7                        1
    8   -      8                        3
    9   -      9                        5
   10   -     10                        1
   11   -     11                        3
   12   -     12                        5
   13   -     13                        1
   14   -     14                        4
   15   -     15                        5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :         S0          :         S3          :
 T   : A:    OF        :                     :                     :
 E   : T:  FATIGUE     :                     :                     :
 P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          1.90 :    0.70:      1.30:     0.70:      1.30:
   2: 1:          0.09 :    0.60:      1.40:     0.60:      1.40:
   3: 1:          0.01 :    0.54:      1.46:     0.54:      1.46:
 S   : M:  NUMBER      :         S4          :         S           :
 T   : A:    OF        :                     :                     :
 E   : T:  FATIGUE     :                     :                     :
 P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          1.90 :   -0.30:      0.30:     0.00:      0.00:
   2: 1:          0.09 :   -0.40:      0.40:     0.00:      0.00:
   3: 1:          0.01 :   -0.46:      0.46:     0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S   : M:  NUMBER      :         S0          :         S3          :
 T   : A:    OF        :                     :                     :
 E   : T:  FATIGUE     :                     :                     :
 P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          0.00 :    1.08:      1.10:     1.08:      1.10:
```

2:	1:	15.09 :	0.87:	1.31:	0.87:	1.31:
3:	1:	1.52 :	0.66:	1.52:	0.66:	1.52:
4:	1:	0.23 :	0.44:	1.74:	0.44:	1.74:
5:	1:	0.05 :	0.22:	1.96:	0.22:	1.96:
6:	1:	0.01 :	0.01:	2.17:	0.01:	2.17:
7:	1:	0.00 :	-0.21:	2.39:	-0.21:	2.39:
8:	1:	0.00 :	-0.43:	2.61:	-0.43:	2.61:
9:	1:	0.00 :	-0.64:	2.82:	-0.64:	2.82:
10:	1:	0.00 :	-0.86:	3.04:	-0.86:	3.04:

S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES :	S4 (t1) :	(t2) :	S (t1) :	(t2) :
1:	1:	0.00 :	-0.01:	0.01:	0.00:	0.00:
2:	1:	15.09 :	-0.22:	0.22:	0.00:	0.00:
3:	1:	1.52 :	-0.43:	0.43:	0.00:	0.00:
4:	1:	0.23 :	-0.65:	0.65:	0.00:	0.00:
5:	1:	0.05 :	-0.87:	0.87:	0.00:	0.00:
6:	1:	0.01 :	-1.08:	1.08:	0.00:	0.00:
7:	1:	0.00 :	-1.30:	1.30:	0.00:	0.00:
8:	1:	0.00 :	-1.52:	1.52:	0.00:	0.00:
9:	1:	0.00 :	-1.73:	1.73:	0.00:	0.00:
10:	1:	0.00 :	-1.95:	1.95:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES :	S0 (t1) :	(t2) :	S3 (t1) :	(t2) :
1:	1:	0.00 :	1.09:	1.11:	1.09:	1.11:
2:	1:	31.10 :	0.88:	1.32:	0.88:	1.32:
3:	1:	2.98 :	0.67:	1.53:	0.67:	1.53:
4:	1:	0.45 :	0.45:	1.75:	0.45:	1.75:
5:	1:	0.09 :	0.23:	1.97:	0.23:	1.97:
6:	1:	0.02 :	0.02:	2.18:	0.02:	2.18:
7:	1:	0.01 :	-0.20:	2.40:	-0.20:	2.40:
8:	1:	0.00 :	-0.42:	2.62:	-0.42:	2.62:
9:	1:	0.00 :	-0.63:	2.83:	-0.63:	2.83:
10:	1:	0.00 :	-0.85:	3.05:	-0.85:	3.05:

S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES :	S4 (t1) :	(t2) :	S (t1) :	(t2) :
1:	1:	0.00 :	-0.01:	0.01:	0.00:	0.00:
2:	1:	31.10 :	-0.22:	0.22:	0.00:	0.00:
3:	1:	2.98 :	-0.43:	0.43:	0.00:	0.00:
4:	1:	0.45 :	-0.65:	0.65:	0.00:	0.00:
5:	1:	0.09 :	-0.87:	0.87:	0.00:	0.00:
6:	1:	0.02 :	-1.08:	1.08:	0.00:	0.00:
7:	1:	0.01 :	-1.30:	1.30:	0.00:	0.00:
8:	1:	0.00 :	-1.52:	1.52:	0.00:	0.00:
9:	1:	0.00 :	-1.73:	1.73:	0.00:	0.00:
10:	1:	0.00 :	-1.95:	1.95:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

S T E	M: A: T:	NUMBER OF FATIGUE :	S0 :	S3 :

P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	0.00	1.09	1.11	1.09	1.11
2: 1:	24.52	0.88	1.32	0.88	1.32
3: 1:	2.73	0.67	1.53	0.67	1.53
4: 1:	0.46	0.45	1.75	0.45	1.75
5: 1:	0.11	0.23	1.97	0.23	1.97
6: 1:	0.03	0.02	2.18	0.02	2.18
7: 1:	0.01	-0.20	2.40	-0.20	2.40
8: 1:	0.00	-0.42	2.62	-0.42	2.62
9: 1:	0.00	-0.63	2.83	-0.63	2.83
10: 1:	0.00	-0.85	3.05	-0.85	3.05

STEP : MAT:	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1: 1:	0.00	-0.01	0.01	0.00	0.00
2: 1:	24.52	-0.22	0.22	0.00	0.00
3: 1:	2.73	-0.43	0.43	0.00	0.00
4: 1:	0.46	-0.65	0.65	0.00	0.00
5: 1:	0.11	-0.87	0.87	0.00	0.00
6: 1:	0.03	-1.08	1.08	0.00	0.00
7: 1:	0.01	-1.30	1.30	0.00	0.00
8: 1:	0.00	-1.52	1.52	0.00	0.00
9: 1:	0.00	-1.73	1.73	0.00	0.00
10: 1:	0.00	-1.95	1.95	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP : MAT:	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1: 1:	0.28	1.00	1.01	1.00	1.01
2: 1:	0.44	0.81	1.06	0.81	1.06
3: 1:	0.22	0.62	1.12	0.62	1.12
4: 1:	0.06	0.43	1.18	0.42	1.18
5: 1:	0.00	0.23	1.24	0.23	1.24
6: 1:	0.00	0.04	1.30	0.04	1.30

STEP : MAT:	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1: 1:	0.28	1.00	1.00	0.00	0.00
2: 1:	0.44	0.81	1.06	0.00	0.00
3: 1:	0.22	0.62	1.12	0.00	0.00
4: 1:	0.06	0.43	1.18	0.00	0.00
5: 1:	0.00	0.23	1.24	0.00	0.00
6: 1:	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W5 crack in .032 skin, outboard sta99
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP : MAT:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

STEP	MAT	NUMBER OF FATIGUE CYCLES	S3 (ksi) (t1)	S3 (ksi) (t2)	S4 (ksi) (t1)	S4 (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W5 crack in .032 skin, outboard sta99
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.00	5.94	6.05	12.10	12.32
2	1	15.09	4.79	7.21	9.74	14.67
3	1	1.52	3.63	8.36	7.39	17.02
4	1	0.23	2.42	9.57	4.93	19.49
5	1	0.05	1.21	10.78	2.46	21.95
6	1	0.01	0.06	11.93	0.11	24.30
7	1	0.00	-1.15	13.15	-2.35	26.77
8	1	0.00	-2.36	14.36	-4.82	29.23
9	1	0.00	-3.52	15.51	-7.17	31.58
10	1	0.00	-4.73	16.72	-9.63	34.05

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	15.09	0.00	0.00	0.00	0.00
3	1	1.52	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.05	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W5 crack in .032 skin, outboard sta99
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.00	5.56	5.66	11.34	11.54
2	1	31.10	4.49	6.73	9.15	13.73

```
  3: 1:          2.98 :    3.42:     7.80:     6.97:    15.91:
  4: 1:          0.45 :    2.30:     8.92:     4.68:    18.20:
  5: 1:          0.09 :    1.17:    10.05:     2.39:    20.49:
  6: 1:          0.02 :    0.10:    11.12:     0.21:    22.67:
  7: 1:          0.01 :   -1.02:    12.24:    -2.08:    24.96:
  8: 1:          0.00 :   -2.14:    13.36:    -4.37:    27.25:
  9: 1:          0.00 :   -3.21:    14.43:    -6.55:    29.43:
 10: 1:          0.00 :   -4.33:    15.55:    -8.84:    31.72:
S   : M:  NUMBER      :         S4        :         S         :
T   : A:    OF        :                   :                   :
E   : T:  FATIGUE     :       (ksi)       :       (ksi)       :
P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
  1: 1:          0.00 :    0.00:     0.00:     0.00:     0.00:
  2: 1:         31.10 :    0.00:     0.00:     0.00:     0.00:
  3: 1:          2.98 :    0.00:     0.00:     0.00:     0.00:
  4: 1:          0.45 :    0.00:     0.00:     0.00:     0.00:
  5: 1:          0.09 :    0.00:     0.00:     0.00:     0.00:
  6: 1:          0.02 :    0.00:     0.00:     0.00:     0.00:
  7: 1:          0.01 :    0.00:     0.00:     0.00:     0.00:
  8: 1:          0.00 :    0.00:     0.00:     0.00:     0.00:
  9: 1:          0.00 :    0.00:     0.00:     0.00:     0.00:
 10: 1:          0.00 :    0.00:     0.00:     0.00:     0.00:
```

```
Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC5, PSE-W5 crack in .032 skin, outboard sta99
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER      :         S0        :         S3        :
T   : A:    OF        :                   :                   :
E   : T:  FATIGUE     :       (ksi)       :       (ksi)       :
P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
  1: 1:          0.00 :    5.67:     5.77:    11.45:    11.66:
  2: 1:         24.52 :    4.58:     6.86:     9.24:    13.86:
  3: 1:          2.73 :    3.48:     7.96:     7.04:    16.07:
  4: 1:          0.46 :    2.34:     9.10:     4.73:    18.38:
  5: 1:          0.11 :    1.20:    10.24:     2.42:    20.69:
  6: 1:          0.03 :    0.10:    11.34:     0.21:    22.89:
  7: 1:          0.01 :   -1.04:    12.48:    -2.10:    25.20:
  8: 1:          0.00 :   -2.18:    13.62:    -4.41:    27.51:
  9: 1:          0.00 :   -3.28:    14.72:    -6.61:    29.71:
 10: 1:          0.00 :   -4.42:    15.86:    -8.92:    32.02:
S   : M:  NUMBER      :         S4        :         S         :
T   : A:    OF        :                   :                   :
E   : T:  FATIGUE     :       (ksi)       :       (ksi)       :
P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:--------------:---------:---------:---------:---------:
  1: 1:          0.00 :    0.00:     0.00:     0.00:     0.00:
  2: 1:         24.52 :    0.00:     0.00:     0.00:     0.00:
  3: 1:          2.73 :    0.00:     0.00:     0.00:     0.00:
  4: 1:          0.46 :    0.00:     0.00:     0.00:     0.00:
  5: 1:          0.11 :    0.00:     0.00:     0.00:     0.00:
  6: 1:          0.03 :    0.00:     0.00:     0.00:     0.00:
  7: 1:          0.01 :    0.00:     0.00:     0.00:     0.00:
  8: 1:          0.00 :    0.00:     0.00:     0.00:     0.00:
  9: 1:          0.00 :    0.00:     0.00:     0.00:     0.00:
 10: 1:          0.00 :    0.00:     0.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC5, PSE-W5 crack in .032 skin, outboard sta99
MODEL: TC05
```

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	3.50	3.54	7.00	7.07
2	1	0.44	2.83	3.71	5.67	7.42
3	1	0.22	2.17	3.92	4.34	7.84
4	1	0.06	1.50	4.13	2.94	8.26
5	1	0.00	0.81	4.34	1.61	8.68
6	1	0.00	0.14	4.55	0.28	9.10

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	0.00	0.00	0.00	0.00
2	1	0.44	0.00	0.00	0.00	0.00
3	1	0.22	0.00	0.00	0.00	0.00
4	1	0.06	0.00	0.00	0.00	0.00
5	1	0.00	0.00	0.00	0.00	0.00
6	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W5 crack in .032 skin, outboard sta99
MODEL: TC05

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
300	15		0.055217	3.864402
600	15		0.060506	3.882839
900	15		0.065868	3.900922
1200	15		0.071302	3.918672
1500	15		0.076811	3.936858
1800	15		0.082400	3.956461
2100	15		0.088079	3.977950
2400	15		0.093859	4.001280
2700	15		0.099749	4.025861
3000	15		0.105755	4.050738
3300	15		0.111879	4.075859
3600	15		0.118124	4.101455
3900	15		0.124495	4.127576
4200	15		0.130995	4.154062
4500	15		0.137629	4.180553
4800	15		0.144397	4.207033
5100	15		0.151302	4.233912
5400	15		0.158349	4.261596
5700	15		0.165545	4.290471
6000	15		0.172901	4.320899
6300	15		0.180429	4.353220
6600	15		0.188142	4.387746
6900	15		0.196056	4.424760
7200	15		0.204192	4.464508
7500	15		0.212570	4.507191
7800	15		0.221212	4.552947
8100	15		0.230143	4.601832
8400	15		0.239390	4.653790
8700	15		0.248978	4.708607

9000	15	0.258933	4.765859
9300	15	0.269278	4.824839
9600	15	0.280032	4.884843
9900	15	0.291213	4.945976
10200	15	0.302840	5.008555
10500	15	0.314937	5.072977
10800	15	0.327532	5.139727
11100	15	0.340659	5.209403
11400	15	0.354358	5.282742
11700	15	0.368680	5.360658
12000	15	0.383687	5.444290
12300	15	0.399458	5.535074
12600	15	0.416092	5.634843
12900	15	0.433718	5.745904
13200	15	0.452500	5.871263
13500	15	0.472656	6.014986
13800	15	0.494483	6.182750
14100	15	0.518397	6.382791
14400	15	0.545005	6.628382
14700	15	0.575527	7.004004

```
ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.   10
Step description:
of Block No.      2  of Schedule No.   14888
Crack Size      c =  0.598323
  15000        15                 0.614991                 7.925954
FINAL RESULTS:
All Stress Intensities are below the Fatigue Threshold.
NO growth in Schedule No.   15222
Crack Size      c =  0.670005
```

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    -----------------------------
                  DATE: 09/30/98    TIME: 07:59:29
           (computed: NASA/FLAGRO Version 2.03, March 1995.)
           U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC5, PSE-W5 crack in .063 skin, inboard sta99

GEOMETRY
--------
MODEL: TC05-Through crack from hole in row of holes.

Plate Thickness, t =     0.0630
Hole Dia., D       =     0.1600
Hole-to-Hole Dist., H       =     0.8000
Dia./Edge-Dist. Ratio, D/B =     0.0000
(D/B = 0 means B is very large)

FLAW SIZE:

c   (init.) =  0.5000E-01


MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; T-L; LA & HHA
```

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

Material Properties:

```
:Matl:  UTS :  YS  :  K1e  :  K1c :  Ak  :  Bk  :  Thk  :  Kc  : KIscc:
: No.:       :      :       :      :      :      :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  65.0:  48.0:  41.0:  29.0: 1.00: 1.00:  0.063:  57.9:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p  :  q  :  DKo  :  Rcl  :Alpha:Smax/:
:    :           :     :     :     :       :       :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.244E-07:2.601:0.50:1.00:  2.90:  0.70: 1.50: 0.30:
 TC5, PSE-W5 crack in .063 skin, inboard sta99
MODEL: TC05

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:   0.00000
Scale Factor for Stress S4:   0.00000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    4.5000
Scale Factor for Stress S3:    14.600
Scale Factor for Stress S4:   0.00000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    4.2000
Scale Factor for Stress S3:    13.700
Scale Factor for Stress S4:   0.00000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    4.2000
Scale Factor for Stress S3:    13.800
Scale Factor for Stress S4:   0.00000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    2.8000
Scale Factor for Stress S3:    9.2000
Scale Factor for Stress S4:   0.00000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                    Block Case No.
From    -    To
    1   -     1                          1
    2   -     2                          2
    3   -     3                          5
    4   -     4                          1
    5   -     5                          3
    6   -     6                          5
    7   -     7                          1
    8   -     8                          3
    9   -     9                          5
   10   -    10                          1
   11   -    11                          3
   12   -    12                          5
   13   -    13                          1
```

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

```
 14   -    14                  4
 15   -    15                  5

BLOCK CASE NO.  1
 S  : M:  NUMBER     :       S0         :        S3         :
 T  : A:    OF       :                  :                   :
 E  : T:  FATIGUE    :                  :                   :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.90 :   0.70:     1.30:    0.70:     1.30:
   2: 1:        0.09 :   0.60:     1.40:    0.60:     1.40:
   3: 1:        0.01 :   0.54:     1.46:    0.54:     1.46:
 S  : M:  NUMBER     :       S4         :        S          :
 T  : A:    OF       :                  :                   :
 E  : T:  FATIGUE    :                  :                   :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.90 :  -0.30:     0.30:    0.00:     0.00:
   2: 1:        0.09 :  -0.40:     0.40:    0.00:     0.00:
   3: 1:        0.01 :  -0.46:     0.46:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER     :       S0         :        S3         :
 T  : A:    OF       :                  :                   :
 E  : T:  FATIGUE    :                  :                   :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.00 :   1.08:     1.10:    1.08:     1.10:
   2: 1:       15.09 :   0.87:     1.31:    0.87:     1.31:
   3: 1:        1.52 :   0.66:     1.52:    0.66:     1.52:
   4: 1:        0.23 :   0.44:     1.74:    0.44:     1.74:
   5: 1:        0.05 :   0.22:     1.96:    0.22:     1.96:
   6: 1:        0.01 :   0.01:     2.17:    0.01:     2.17:
   7: 1:        0.00 :  -0.21:     2.39:   -0.21:     2.39:
   8: 1:        0.00 :  -0.43:     2.61:   -0.43:     2.61:
   9: 1:        0.00 :  -0.64:     2.82:   -0.64:     2.82:
  10: 1:        0.00 :  -0.86:     3.04:   -0.86:     3.04:
 S  : M:  NUMBER     :       S4         :        S          :
 T  : A:    OF       :                  :                   :
 E  : T:  FATIGUE    :                  :                   :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.00 :  -0.01:     0.01:    0.00:     0.00:
   2: 1:       15.09 :  -0.22:     0.22:    0.00:     0.00:
   3: 1:        1.52 :  -0.43:     0.43:    0.00:     0.00:
   4: 1:        0.23 :  -0.65:     0.65:    0.00:     0.00:
   5: 1:        0.05 :  -0.87:     0.87:    0.00:     0.00:
   6: 1:        0.01 :  -1.08:     1.08:    0.00:     0.00:
   7: 1:        0.00 :  -1.30:     1.30:    0.00:     0.00:
   8: 1:        0.00 :  -1.52:     1.52:    0.00:     0.00:
   9: 1:        0.00 :  -1.73:     1.73:    0.00:     0.00:
  10: 1:        0.00 :  -1.95:     1.95:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S  : M:  NUMBER     :       S0         :        S3         :
 T  : A:    OF       :                  :                   :
 E  : T:  FATIGUE    :                  :                   :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.00 :   1.06:     1.08:    1.08:     1.10:
   2: 1:       31.10 :   0.85:     1.29:    0.87:     1.31:
```

```
   3: 1:        2.98 :   0.64:    1.50:    0.66:    1.52:
   4: 1:        0.45 :   0.42:    1.72:    0.44:    1.74:
   5: 1:        0.09 :   0.20:    1.94:    0.22:    1.96:
   6: 1:        0.02 :  -0.01:    2.15:    0.01:    2.17:
   7: 1:        0.01 :  -0.23:    2.37:   -0.21:    2.39:
   8: 1:        0.00 :  -0.45:    2.59:   -0.43:    2.61:
   9: 1:        0.00 :  -0.66:    2.80:   -0.64:    2.82:
  10: 1:        0.00 :  -0.88:    3.02:   -0.86:    3.04:
 S  : M:  NUMBER     :        S4        :        S        :
 T  : A:    OF       :                  :                 :
 E  : T:  FATIGUE    :                  :                 :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)  :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.00 :  -0.01:    0.01:    0.00:    0.00:
   2: 1:       31.10 :  -0.22:    0.22:    0.00:    0.00:
   3: 1:        2.98 :  -0.43:    0.43:    0.00:    0.00:
   4: 1:        0.45 :  -0.65:    0.65:    0.00:    0.00:
   5: 1:        0.09 :  -0.87:    0.87:    0.00:    0.00:
   6: 1:        0.02 :  -1.08:    1.08:    0.00:    0.00:
   7: 1:        0.01 :  -1.30:    1.30:    0.00:    0.00:
   8: 1:        0.00 :  -1.52:    1.52:    0.00:    0.00:
   9: 1:        0.00 :  -1.73:    1.73:    0.00:    0.00:
  10: 1:        0.00 :  -1.95:    1.95:    0.00:    0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
 S  : M:  NUMBER     :        S0        :        S3       :
 T  : A:    OF       :                  :                 :
 E  : T:  FATIGUE    :                  :                 :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)  :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.00 :   1.09:    1.11:    1.08:    1.10:
   2: 1:       24.52 :   0.88:    1.32:    0.87:    1.31:
   3: 1:        2.73 :   0.67:    1.53:    0.66:    1.52:
   4: 1:        0.46 :   0.45:    1.75:    0.44:    1.74:
   5: 1:        0.11 :   0.23:    1.97:    0.22:    1.96:
   6: 1:        0.03 :   0.02:    2.18:    0.01:    2.17:
   7: 1:        0.01 :  -0.20:    2.40:   -0.21:    2.39:
   8: 1:        0.00 :  -0.42:    2.62:   -0.43:    2.61:
   9: 1:        0.00 :  -0.63:    2.83:   -0.64:    2.82:
  10: 1:        0.00 :  -0.85:    3.05:   -0.86:    3.04:
 S  : M:  NUMBER     :        S4        :        S        :
 T  : A:    OF       :                  :                 :
 E  : T:  FATIGUE    :                  :                 :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)  :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.00 :  -0.01:    0.01:    0.00:    0.00:
   2: 1:       24.52 :  -0.22:    0.22:    0.00:    0.00:
   3: 1:        2.73 :  -0.43:    0.43:    0.00:    0.00:
   4: 1:        0.46 :  -0.65:    0.65:    0.00:    0.00:
   5: 1:        0.11 :  -0.87:    0.87:    0.00:    0.00:
   6: 1:        0.03 :  -1.08:    1.08:    0.00:    0.00:
   7: 1:        0.01 :  -1.30:    1.30:    0.00:    0.00:
   8: 1:        0.00 :  -1.52:    1.52:    0.00:    0.00:
   9: 1:        0.00 :  -1.73:    1.73:    0.00:    0.00:
  10: 1:        0.00 :  -1.95:    1.95:    0.00:    0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  5
 S  : M:  NUMBER     :        S0        :        S3       :
 T  : A:    OF       :                  :                 :
 E  : T:  FATIGUE    :                  :                 :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)  :
```

1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.00	0.00	0.00
2	1	0.44	0.81	1.06	0.00	0.00
3	1	0.22	0.62	1.12	0.00	0.00
4	1	0.06	0.43	1.18	0.00	0.00
5	1	0.00	0.23	1.24	0.00	0.00
6	1	0.00	0.04	1.30	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W5 crack in .063 skin, inboard sta99
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W5 crack in .063 skin, inboard sta99
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.00	4.86	4.95	15.77	16.06
2	1	15.09	3.92	5.90	12.70	19.13
3	1	1.52	2.97	6.84	9.64	22.19
4	1	0.23	1.98	7.83	6.42	25.40
5	1	0.05	0.99	8.82	3.21	28.62
6	1	0.01	0.05	9.77	0.15	31.68
7	1	0.00	-0.94	10.76	-3.07	34.89
8	1	0.00	-1.93	11.75	-6.28	38.11
9	1	0.00	-2.88	12.69	-9.34	41.17
10	1	0.00	-3.87	13.68	-12.56	44.38

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	15.09	0.00	0.00	0.00	0.00
3	1	1.52	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.05	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W5 crack in .063 skin, inboard sta99
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.00	4.45	4.54	14.80	15.07
2	1	31.10	3.57	5.42	11.92	17.95
3	1	2.98	2.69	6.30	9.04	20.82
4	1	0.45	1.76	7.22	6.03	23.84
5	1	0.09	0.84	8.15	3.01	26.85
6	1	0.02	-0.04	9.03	0.14	29.73
7	1	0.01	-0.97	9.95	-2.88	32.74
8	1	0.00	-1.89	10.88	-5.89	35.76
9	1	0.00	-2.77	11.76	-8.77	38.63
10	1	0.00	-3.70	12.68	-11.78	41.65

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	31.10	0.00	0.00	0.00	0.00
3	1	2.98	0.00	0.00	0.00	0.00
4	1	0.45	0.00	0.00	0.00	0.00
5	1	0.09	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W5 crack in .063 skin, inboard sta99
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

1	1	0.00	4.58	4.66	14.90	15.18
2	1	24.52	3.70	5.54	12.01	18.08
3	1	2.73	2.81	6.43	9.11	20.98
4	1	0.46	1.89	7.35	6.07	24.01
5	1	0.11	0.97	8.27	3.04	27.05
6	1	0.03	0.08	9.16	0.14	29.95
7	1	0.01	-0.84	10.08	-2.90	32.98
8	1	0.00	-1.76	11.00	-5.93	36.02
9	1	0.00	-2.65	11.89	-8.83	38.92
10	1	0.00	-3.57	12.81	-11.87	41.95

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.00	0.00	0.00	0.00	0.00
2	1	24.52	0.00	0.00	0.00	0.00
3	1	2.73	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.11	0.00	0.00	0.00	0.00
6	1	0.03	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W5 crack in .063 skin, inboard sta99
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	2.80	2.83	9.20	9.29
2	1	0.44	2.27	2.97	7.45	9.75
3	1	0.22	1.74	3.14	5.70	10.30
4	1	0.06	1.20	3.30	3.86	10.86
5	1	0.00	0.64	3.47	2.12	11.41
6	1	0.00	0.11	3.64	0.37	11.96

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	0.00	0.00	0.00	0.00
2	1	0.44	0.00	0.00	0.00	0.00
3	1	0.22	0.00	0.00	0.00	0.00
4	1	0.06	0.00	0.00	0.00	0.00
5	1	0.00	0.00	0.00	0.00	0.00
6	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W5 crack in .063 skin, inboard sta99
MODEL: TC05

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
300	15		0.057994	4.352223
600	15		0.066048	4.363221
900	15		0.074150	4.373101
1200	15		0.082308	4.385755
1500	15		0.090545	4.402176
1800	15		0.098882	4.420303
2100	15		0.107322	4.438143
2400	15		0.115867	4.456345
2700	15		0.124522	4.474919
3000	15		0.133287	4.493045
3300	15		0.142162	4.510911
3600	15		0.151150	4.529738
3900	15		0.160260	4.550580
4200	15		0.169512	4.574312
4500	15		0.178926	4.601648
4800	15		0.188533	4.633148
5100	15		0.198362	4.669220
5400	15		0.208450	4.710103
5700	15		0.218835	4.755829
6000	15		0.229556	4.806163
6300	15		0.240650	4.860507
6600	15		0.252154	4.917769
6900	15		0.264091	4.976351
7200	15		0.276480	5.035798
7500	15		0.289340	5.096705
7800	15		0.302699	5.159819
8100	15		0.316589	5.226053
8400	15		0.331057	5.296520
8700	15		0.346160	5.372596
9000	15		0.361974	5.456002
9300	15		0.378600	5.548928
9600	15		0.396171	5.654246
9900	15		0.414866	5.775938
10200	15		0.434932	5.919650
10500	15		0.456722	6.093620
10800	15		0.480760	6.310526
11100	15		0.507870	6.591262

```
ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.   10
Step description:
of Block No.      2   of Schedule No.   11299
Crack Size       c =  0.528113
  11400        15                0.539547                  7.004773
  11700        15                0.581860                  8.101987
FINAL RESULTS:
All Stress Intensities are below the Fatigue Threshold.
NO growth in Schedule No.   11893
Crack Size       c =  0.640004

                    FATIGUE CRACK GROWTH ANALYSIS
                    -------Modified by FAI-------
                  DATE: 27-APR-99   TIME: 08:22:41
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 1, PSE-W5 crack in .063 skin, 2 holes    (

GEOMETRY
--------
MODEL: TC01-Through crack in center of plate.
```

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

```
Plate Thickness, t =    0.0630
  "   Width, W     =   24.0000

FLAW SIZE:

c   (init.) =  0.4850




MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  66.0:  53.0:  46.0:  33.0: 1.00: 1.00:  0.063:  65.9:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.829D-08:3.284:0.50:1.00:  2.90:  0.70: 1.50: 0.30:

MODEL: TC01

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.5000
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    7.4200
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    6.9400
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    6.9600
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S1:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                 Block Case No.
From   -   To
    1   -     1                      1
```

2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.08	1.10	-0.01	0.01
2	1	15.09	0.87	1.31	-0.22	0.22
3	1	1.52	0.66	1.52	-0.43	0.43
4	1	0.23	0.44	1.74	-0.65	0.65
5	1	0.05	0.22	1.96	-0.87	0.87
6	1	0.01	0.01	2.17	-1.08	1.08
7	1	0.00	-0.21	2.39	-1.30	1.30
8	1	0.00	-0.43	2.61	-1.52	1.52
9	1	0.00	-0.64	2.82	-1.73	1.73
10	1	0.00	-0.86	3.04	-1.95	1.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.06	1.08	-0.01	0.01
2	1	31.10	0.85	1.29	-0.22	0.22
3	1	2.98	0.64	1.50	-0.43	0.43
4	1	0.45	0.42	1.72	-0.65	0.65
5	1	0.09	0.20	1.94	-0.87	0.87
6	1	0.02	-0.01	2.15	-1.08	1.08
7	1	0.01	-0.23	2.37	-1.30	1.30
8	1	0.00	-0.45	2.59	-1.52	1.52
9	1	0.00	-0.66	2.80	-1.73	1.73
10	1	0.00	-0.88	3.02	-1.95	1.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

S T E P	M A T L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.09	1.11	-0.01	0.01
2	1	24.52	0.88	1.32	-0.22	0.22
3	1	2.73	0.67	1.53	-0.43	0.43
4	1	0.46	0.45	1.75	-0.65	0.65
5	1	0.11	0.23	1.97	-0.87	0.87
6	1	0.03	0.02	2.18	-1.08	1.08
7	1	0.01	-0.20	2.40	-1.30	1.30
8	1	0.00	-0.42	2.62	-1.52	1.52
9	1	0.00	-0.63	2.83	-1.73	1.73
10	1	0.00	-0.85	3.05	-1.95	1.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

S T E P	M A T L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S T E P	M A T L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	-1.05	-1.95	0.00	0.00
2	1	0.09	-0.90	-2.10	0.00	0.00
3	1	0.01	-0.81	-2.19	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S T E P	M A T L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	8.01	8.16	0.00	0.00

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

2	1	15.09	6.46	9.72	0.00	0.00
3	1	1.52	4.90	11.28	0.00	0.00
4	1	0.23	3.26	12.91	0.00	0.00
5	1	0.05	1.63	14.54	0.00	0.00
6	1	0.01	0.07	16.10	0.00	0.00
7	1	0.00	-1.56	17.73	0.00	0.00
8	1	0.00	-3.19	19.37	0.00	0.00
9	1	0.00	-4.75	20.92	0.00	0.00
10	1	0.00	-6.38	22.56	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	7.36	7.50	0.00	0.00
2	1	31.10	5.90	8.95	0.00	0.00
3	1	2.98	4.44	10.41	0.00	0.00
4	1	0.45	2.91	11.94	0.00	0.00
5	1	0.09	1.39	13.46	0.00	0.00
6	1	0.02	-0.07	14.92	0.00	0.00
7	1	0.01	-1.60	16.45	0.00	0.00
8	1	0.00	-3.12	17.97	0.00	0.00
9	1	0.00	-4.58	19.43	0.00	0.00
10	1	0.00	-6.11	20.96	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	7.59	7.73	0.00	0.00
2	1	24.52	6.12	9.19	0.00	0.00
3	1	2.73	4.66	10.65	0.00	0.00
4	1	0.46	3.13	12.18	0.00	0.00
5	1	0.11	1.60	13.71	0.00	0.00
6	1	0.03	0.14	15.17	0.00	0.00
7	1	0.01	-1.39	16.70	0.00	0.00
8	1	0.00	-2.92	18.24	0.00	0.00
9	1	0.00	-4.38	19.70	0.00	0.00
10	1	0.00	-5.92	21.23	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S T E P	M A T L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28 :	4.64:	4.69:	0.00:	0.00:
2:	1:	0.44 :	3.76:	4.92:	0.00:	0.00:
3:	1:	0.22 :	2.88:	5.20:	0.00:	0.00:
4:	1:	0.06 :	2.00:	5.48:	0.00:	0.00:
5:	1:	0.00 :	1.07:	5.75:	0.00:	0.00:
6:	1:	0.00 :	0.19:	6.03:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
100	15		0.499022	7.560659
200	15		0.513820	7.672440
300	15		0.529461	7.788882
400	15		0.546016	7.910319
500	15		0.563567	8.037118
600	15		0.582205	8.169688
700	15		0.602034	8.308482
800	15		0.623169	8.454005
900	15		0.645744	8.606827
1000	15		0.669909	8.767586
1100	15		0.695837	8.937006
1200	15		0.723728	9.115908
1300	15		0.753814	9.305232
1400	15		0.786364	9.506058
1500	15		0.821695	9.719640
1600	15		0.860183	9.947435
1700	15		0.902274	10.191160
1800	15		0.948508	10.452854
1900	15		0.999540	10.734959
2000	15		1.056177	11.040442
2100	15		1.119423	11.372949
2200	15		1.190554	11.737040
2300	15		1.271212	12.138516
2400	15		1.363559	12.584927
2500	15		1.470514	13.086360
2600	15		1.596147	13.656747
2700	15		1.746355	14.316156
2800	15		1.930146	15.095139
2900	15		2.162314	16.044002
3000	15		2.470214	17.256753

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max = 65.86 K ref = 0.000 K cr = 65.86
at the very beginning of Load Step No. 10
Step description:
of Block No. 2 of Schedule No. 3025
Crack Size c = 2.56243

FATIGUE CRACK GROWTH ANALYSIS
-------Modified by FAI-------
DATE: 27-APR-99 TIME: 08:24:04
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

```
PROBLEM TITLE
-------------
THROUGH CRACK CASE 1, PSE-W5 crack in .063 skin, 4 holes    (

GEOMETRY
--------
MODEL: TC01-Through crack in center of plate.

Plate Thickness, t =    0.0630
  "   Width, W     =   24.0000

FLAW SIZE:

c   (init.) =   1.285


MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  Kle :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  66.0:  53.0:  46.0:  33.0: 1.00: 1.00:  0.063:  65.9:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:----------:-----:----:----:------:------:-----:-----:
:  1 :0.829D-08:3.284:0.50:1.00:  2.90:  0.70: 1.50: 0.30:

MODEL: TC01

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.5000
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    7.4200
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    6.9400
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    6.9600
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  5
```

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

```
Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S1:    0.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
   1   -    1                        1
   2   -    2                        2
   3   -    3                        5
   4   -    4                        1
   5   -    5                        3
   6   -    6                        5
   7   -    7                        1
   8   -    8                        3
   9   -    9                        5
  10   -   10                        1
  11   -   11                        3
  12   -   12                        5
  13   -   13                        1
  14   -   14                        4
  15   -   15                        5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :         S0          :         S1          :
 T   : A:    OF        :                     :                     :
 E   : T:  FATIGUE     :                     :                     :
 P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:    0.70:     1.30:
   2: 1:         0.09 :    0.60:     1.40:    0.60:     1.40:
   3: 1:         0.01 :    0.54:     1.46:    0.54:     1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S   : M:  NUMBER      :         S0          :         S1          :
 T   : A:    OF        :                     :                     :
 E   : T:  FATIGUE     :                     :                     :
 P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :    1.08:     1.10:   -0.01:     0.01:
   2: 1:        15.09 :    0.87:     1.31:   -0.22:     0.22:
   3: 1:         1.52 :    0.66:     1.52:   -0.43:     0.43:
   4: 1:         0.23 :    0.44:     1.74:   -0.65:     0.65:
   5: 1:         0.05 :    0.22:     1.96:   -0.87:     0.87:
   6: 1:         0.01 :    0.01:     2.17:   -1.08:     1.08:
   7: 1:         0.00 :   -0.21:     2.39:   -1.30:     1.30:
   8: 1:         0.00 :   -0.43:     2.61:   -1.52:     1.52:
   9: 1:         0.00 :   -0.64:     2.82:   -1.73:     1.73:
  10: 1:         0.00 :   -0.86:     3.04:   -1.95:     1.95:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S   : M:  NUMBER      :         S0          :         S1          :
 T   : A:    OF        :                     :                     :
 E   : T:  FATIGUE     :                     :                     :
 P   : L:  CYCLES      :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.00 :    1.06:     1.08:   -0.01:     0.01:
   2: 1:        31.10 :    0.85:     1.29:   -0.22:     0.22:
   3: 1:         2.98 :    0.64:     1.50:   -0.43:     0.43:
   4: 1:         0.45 :    0.42:     1.72:   -0.65:     0.65:
```

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

5:	1:	0.09 :	0.20:	1.94:	-0.87:	0.87:
6:	1:	0.02 :	-0.01:	2.15:	-1.08:	1.08:
7:	1:	0.01 :	-0.23:	2.37:	-1.30:	1.30:
8:	1:	0.00 :	-0.45:	2.59:	-1.52:	1.52:
9:	1:	0.00 :	-0.66:	2.80:	-1.73:	1.73:
10:	1:	0.00 :	-0.88:	3.02:	-1.95:	1.95:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	0.00 :	1.09:	1.11:	-0.01:	0.01:
2:	1:	24.52 :	0.88:	1.32:	-0.22:	0.22:
3:	1:	2.73 :	0.67:	1.53:	-0.43:	0.43:
4:	1:	0.46 :	0.45:	1.75:	-0.65:	0.65:
5:	1:	0.11 :	0.23:	1.97:	-0.87:	0.87:
6:	1:	0.03 :	0.02:	2.18:	-1.08:	1.08:
7:	1:	0.01 :	-0.20:	2.40:	-1.30:	1.30:
8:	1:	0.00 :	-0.42:	2.62:	-1.52:	1.52:
9:	1:	0.00 :	-0.63:	2.83:	-1.73:	1.73:
10:	1:	0.00 :	-0.85:	3.05:	-1.95:	1.95:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1:	1:	0.28 :	1.00:	1.01:	1.00:	1.01:
2:	1:	0.44 :	0.81:	1.06:	0.81:	1.06:
3:	1:	0.22 :	0.62:	1.12:	0.62:	1.12:
4:	1:	0.06 :	0.43:	1.18:	0.42:	1.18:
5:	1:	0.00 :	0.23:	1.24:	0.23:	1.24:
6:	1:	0.00 :	0.04:	1.30:	0.04:	1.30:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	1.90 :	-1.05:	-1.95:	0.00:	0.00:
2:	1:	0.09 :	-0.90:	-2.10:	0.00:	0.00:
3:	1:	0.01 :	-0.81:	-2.19:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	8.01	8.16	0.00	0.00
2	1	15.09	6.46	9.72	0.00	0.00
3	1	1.52	4.90	11.28	0.00	0.00
4	1	0.23	3.26	12.91	0.00	0.00
5	1	0.05	1.63	14.54	0.00	0.00
6	1	0.01	0.07	16.10	0.00	0.00
7	1	0.00	-1.56	17.73	0.00	0.00
8	1	0.00	-3.19	19.37	0.00	0.00
9	1	0.00	-4.75	20.92	0.00	0.00
10	1	0.00	-6.38	22.56	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	7.36	7.50	0.00	0.00
2	1	31.10	5.90	8.95	0.00	0.00
3	1	2.98	4.44	10.41	0.00	0.00
4	1	0.45	2.91	11.94	0.00	0.00
5	1	0.09	1.39	13.46	0.00	0.00
6	1	0.02	-0.07	14.92	0.00	0.00
7	1	0.01	-1.60	16.45	0.00	0.00
8	1	0.00	-3.12	17.97	0.00	0.00
9	1	0.00	-4.58	19.43	0.00	0.00
10	1	0.00	-6.11	20.96	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.00	7.59	7.73	0.00	0.00
2	1	24.52	6.12	9.19	0.00	0.00
3	1	2.73	4.66	10.65	0.00	0.00
4	1	0.46	3.13	12.18	0.00	0.00
5	1	0.11	1.60	13.71	0.00	0.00
6	1	0.03	0.14	15.17	0.00	0.00
7	1	0.01	-1.39	16.70	0.00	0.00
8	1	0.00	-2.92	18.24	0.00	0.00
9	1	0.00	-4.38	19.70	0.00	0.00
10	1	0.00	-5.92	21.23	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.28	4.64	4.69	0.00	0.00
2	1	0.44	3.76	4.92	0.00	0.00
3	1	0.22	2.88	5.20	0.00	0.00
4	1	0.06	2.00	5.48	0.00	0.00
5	1	0.00	1.07	5.75	0.00	0.00
6	1	0.00	0.19	6.03	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
100	15		1.379443	12.660404
200	15		1.489049	13.171710
300	15		1.618122	13.754661
400	15		1.772945	14.430618
500	15		1.963205	15.232448
600	15		2.205055	16.215118
700	15		2.529322	17.484939

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max = 65.87 K ref = 0.000 K cr = 65.86
at the very beginning of Load Step No. 10
Step description:
of Block No. 2 of Schedule No. 709
Crack Size c = 2.56272

FATIGUE CRACK GROWTH ANALYSIS
-------Modified by FAI-------
DATE: 27-APR-99 TIME: 08:56:38
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

THROUGH CRACK CASE 1, PSE-W5 crack in .063 skin, 6 holes (

GEOMETRY

MODEL: TC01-Through crack in center of plate.

Plate Thickness, t = 0.0630
" Width, W = 24.0000

FLAW SIZE:

```
c   (init.) =    2.085


MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak  :  Bk  :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :      :      :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  66.0:  53.0:  46.0:  33.0: 1.00: 1.00:  0.063:  65.9:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.829D-08:3.284:0.50:1.00:  2.90:  0.70: 1.50: 0.30:

MODEL: TC01

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.5000
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    7.4200
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    6.9400
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    6.9600
Scale Factor for Stress S1:    0.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    4.6400
Scale Factor for Stress S1:    0.0000

Total No. of Blocks in Schedule =     15

   Block Number and Case Correspondences
  Block Number                 Block Case No.
 From   -   To
    1   -    1                        1
    2   -    2                        2
    3   -    3                        5
    4   -    4                        1
    5   -    5                        3
    6   -    6                        5
```

7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.08	1.10	-0.01	0.01
2	1	15.09	0.87	1.31	-0.22	0.22
3	1	1.52	0.66	1.52	-0.43	0.43
4	1	0.23	0.44	1.74	-0.65	0.65
5	1	0.05	0.22	1.96	-0.87	0.87
6	1	0.01	0.01	2.17	-1.08	1.08
7	1	0.00	-0.21	2.39	-1.30	1.30
8	1	0.00	-0.43	2.61	-1.52	1.52
9	1	0.00	-0.64	2.82	-1.73	1.73
10	1	0.00	-0.86	3.04	-1.95	1.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.00	1.06	1.08	-0.01	0.01
2	1	31.10	0.85	1.29	-0.22	0.22
3	1	2.98	0.64	1.50	-0.43	0.43
4	1	0.45	0.42	1.72	-0.65	0.65
5	1	0.09	0.20	1.94	-0.87	0.87
6	1	0.02	-0.01	2.15	-1.08	1.08
7	1	0.01	-0.23	2.37	-1.30	1.30
8	1	0.00	-0.45	2.59	-1.52	1.52
9	1	0.00	-0.66	2.80	-1.73	1.73
10	1	0.00	-0.88	3.02	-1.95	1.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

S T	M: A:	NUMBER OF	S0	S1

E : T:	FATIGUE				
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	0.00	1.09	1.11	-0.01	0.01
2: 1:	24.52	0.88	1.32	-0.22	0.22
3: 1:	2.73	0.67	1.53	-0.43	0.43
4: 1:	0.46	0.45	1.75	-0.65	0.65
5: 1:	0.11	0.23	1.97	-0.87	0.87
6: 1:	0.03	0.02	2.18	-1.08	1.08
7: 1:	0.01	-0.20	2.40	-1.30	1.30
8: 1:	0.00	-0.42	2.62	-1.52	1.52
9: 1:	0.00	-0.63	2.83	-1.73	1.73
10: 1:	0.00	-0.85	3.05	-1.95	1.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

S : M:	NUMBER	S0		S1	
T : A:	OF				
E : T:	FATIGUE				
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	0.28	1.00	1.01	1.00	1.01
2: 1:	0.44	0.81	1.06	0.81	1.06
3: 1:	0.22	0.62	1.12	0.62	1.12
4: 1:	0.06	0.43	1.18	0.42	1.18
5: 1:	0.00	0.23	1.24	0.23	1.24
6: 1:	0.00	0.04	1.30	0.04	1.30

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S : M:	NUMBER	S0		S1	
T : A:	OF				
E : T:	FATIGUE	(ksi)		(ksi)	
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	1.90	-1.05	-1.95	0.00	0.00
2: 1:	0.09	-0.90	-2.10	0.00	0.00
3: 1:	0.01	-0.81	-2.19	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S : M:	NUMBER	S0		S1	
T : A:	OF				
E : T:	FATIGUE	(ksi)		(ksi)	
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	0.00	8.01	8.16	0.00	0.00
2: 1:	15.09	6.46	9.72	0.00	0.00
3: 1:	1.52	4.90	11.28	0.00	0.00
4: 1:	0.23	3.26	12.91	0.00	0.00
5: 1:	0.05	1.63	14.54	0.00	0.00
6: 1:	0.01	0.07	16.10	0.00	0.00

C-5 PSE W5 SA227 Skin Splice at WS 99 Lower Surface (Continued)

7:	1:	0.00 :	-1.56:	17.73:	0.00:	0.00:
8:	1:	0.00 :	-3.19:	19.37:	0.00:	0.00:
9:	1:	0.00 :	-4.75:	20.92:	0.00:	0.00:
10:	1:	0.00 :	-6.38:	22.56:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.00 :	7.36:	7.50:	0.00:	0.00:
2:	1:	31.10 :	5.90:	8.95:	0.00:	0.00:
3:	1:	2.98 :	4.44:	10.41:	0.00:	0.00:
4:	1:	0.45 :	2.91:	11.94:	0.00:	0.00:
5:	1:	0.09 :	1.39:	13.46:	0.00:	0.00:
6:	1:	0.02 :	-0.07:	14.92:	0.00:	0.00:
7:	1:	0.01 :	-1.60:	16.45:	0.00:	0.00:
8:	1:	0.00 :	-3.12:	17.97:	0.00:	0.00:
9:	1:	0.00 :	-4.58:	19.43:	0.00:	0.00:
10:	1:	0.00 :	-6.11:	20.96:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.00 :	7.59:	7.73:	0.00:	0.00:
2:	1:	24.52 :	6.12:	9.19:	0.00:	0.00:
3:	1:	2.73 :	4.66:	10.65:	0.00:	0.00:
4:	1:	0.46 :	3.13:	12.18:	0.00:	0.00:
5:	1:	0.11 :	1.60:	13.71:	0.00:	0.00:
6:	1:	0.03 :	0.14:	15.17:	0.00:	0.00:
7:	1:	0.01 :	-1.39:	16.70:	0.00:	0.00:
8:	1:	0.00 :	-2.92:	18.24:	0.00:	0.00:
9:	1:	0.00 :	-4.38:	19.70:	0.00:	0.00:
10:	1:	0.00 :	-5.92:	21.23:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)

```
1: 1:        0.28 :     4.64:     4.69:     0.00:     0.00:
2: 1:        0.44 :     3.76:     4.92:     0.00:     0.00:
3: 1:        0.22 :     2.88:     5.20:     0.00:     0.00:
4: 1:        0.06 :     2.00:     5.48:     0.00:     0.00:
5: 1:        0.00 :     1.07:     5.75:     0.00:     0.00:
6: 1:        0.00 :     0.19:     6.03:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

ANALYSIS RESULTS:
-----------------


 Schedl    Block             Final Flaw Size           K max
                 Step               c                  c-tip
   100      15                  2.365523             16.849254

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     65.89     K ref =    0.000     K cr =    65.86
at the very beginning of Load Step No.   10
Step description:
of Block No.      2  of Schedule No.     156
Crack Size     c =   2.56468
```

C-6 PSE W6 SA227 Wing Extension Fitting Main Spar Lower Surface

```
                     FATIGUE CRACK GROWTH ANALYSIS
                     -----------------------------
                   DATE: 08/31/98    TIME: 14:08:48
            (computed: NASA/FLAGRO Version 2.03, March 1995.)
            U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
PSE-W6, TC03, crack in .071" strap @ 16,500 lbs    (Title)

GEOMETRY
--------
MODEL: TC03-Through crack from hole in plate.

Plate Thickness, t =    0.0710
  "   Width, W     =    0.8000
Hole Diameter, D   =    0.1900
Hole-Center-to-Edge Dist., B =    0.3800

FLAW SIZE:

c   (init.) =  0.5000E-01



MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  66.0:  53.0:  46.0:  33.0: 1.00: 1.00:  0.071:  65.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.829E-08:3.284:0.50:1.00:  2.90:  0.70: 1.50: 0.30:
 PSE-W6, TC03, crack in .071" strap @ 16,500 lbs    (Title)
MODEL: TC03

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:   0.00000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    1.3000
Scale Factor for Stress S3:    6.8500
```

C-6 PSE W6 SA227 Wing Extension Fitting Main Spar Lower Surface (Continued)

```
Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    1.3000
Scale Factor for Stress S3:    6.8500
Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    1.3000
Scale Factor for Stress S3:    6.8500

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:   0.58000
Scale Factor for Stress S3:    3.0700

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                    Block Case No.
From    -    To
    1   -     1                         1
    2   -     2                         2
    3   -     3                         5
    4   -     4                         1
    5   -     5                         3
    6   -     6                         5
    7   -     7                         1
    8   -     8                         3
    9   -     9                         5
   10   -    10                         1
   11   -    11                         3
   12   -    12                         5
   13   -    13                         1
   14   -    14                         4
   15   -    15                         5

BLOCK CASE NO.  1
 S  : M:  NUMBER     :         S0          :         S3          :
 T  : A:    OF       :                     :                     :
 E  : T:  FATIGUE    :                     :                     :
 P  : L:  CYCLES     :   (t1)  :  (t2)     :   (t1)  :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:      1.30:     0.70:      1.30:
   2: 1:         0.09 :    0.60:      1.40:     0.60:      1.40:
   3: 1:         0.01 :    0.54:      1.46:     0.54:      1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER     :         S0          :         S3          :
 T  : A:    OF       :                     :                     :
 E  : T:  FATIGUE    :                     :                     :
 P  : L:  CYCLES     :   (t1)  :  (t2)     :   (t1)  :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :    0.45:      1.05:     0.45:      1.05:
   2: 1:         1.14 :    0.25:      1.25:     0.25:      1.25:
   3: 1:         0.57 :    0.15:      1.35:     0.15:      1.35:
   4: 1:         0.11 :   -0.05:      1.55:    -0.05:      1.55:
   5: 1:         0.02 :   -0.25:      1.75:    -0.25:      1.75:
   6: 1:         0.01 :   -0.45:      1.95:    -0.45:      1.95:
   7: 1:         0.00 :   -0.65:      2.15:    -0.65:      2.15:
   8: 1:         0.00 :   -0.85:      2.35:    -0.85:      2.35:
   9: 1:         0.00 :   -1.05:      2.55:    -1.05:      2.55:
  10: 1:         0.00 :   -1.25:      2.75:    -1.25:      2.75:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
```

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	0.45	1.05	0.45	1.05
2	1	2.29	0.25	1.25	0.25	1.25
3	1	1.14	0.15	1.35	0.15	1.35
4	1	0.23	-0.05	1.55	-0.05	1.55
5	1	0.04	-0.25	1.75	-0.25	1.75
6	1	0.01	-0.45	1.95	-0.45	1.95
7	1	0.00	-0.65	2.15	-0.65	2.15
8	1	0.00	-0.85	2.35	-0.85	2.35
9	1	0.00	-1.05	2.55	-1.05	2.55
10	1	0.00	-1.25	2.75	-1.25	2.75

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	0.45	1.05	0.45	1.05
2	1	4.57	0.25	1.25	0.25	1.25
3	1	2.29	0.15	1.35	0.15	1.35
4	1	0.46	-0.05	1.55	-0.05	1.55
5	1	0.08	-0.25	1.75	-0.25	1.75
6	1	0.02	-0.45	1.95	-0.45	1.95
7	1	0.01	-0.65	2.15	-0.65	2.15
8	1	0.00	-0.85	2.35	-0.85	2.35
9	1	0.00	-1.05	2.55	-1.05	2.55
10	1	0.00	-1.25	2.75	-1.25	2.75

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.80	1.10	0.80	1.10
3	1	0.22	0.60	1.20	0.60	1.20
4	1	0.06	0.40	1.30	0.40	1.30
5	1	0.00	0.20	1.40	0.20	1.40
6	1	0.00	0.00	1.50	0.00	1.50

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W6, TC03, crack in .071" strap @ 16,500 lbs (Title)
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE	S0 (ksi)	S3 (ksi)

C-6 PSE W6 SA227 Wing Extension Fitting Main Spar Lower Surface (Continued)

P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W6, TC03, crack in .071" strap @ 16,500 lbs (Title)
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	0.59	1.37	3.08	7.19
2	1	1.14	0.33	1.63	1.71	8.56
3	1	0.57	0.20	1.76	1.03	9.25
4	1	0.11	-0.07	2.02	-0.34	10.62
5	1	0.02	-0.33	2.27	-1.71	11.99
6	1	0.01	-0.58	2.54	-3.08	13.36
7	1	0.00	-0.84	2.79	-4.45	14.73
8	1	0.00	-1.11	3.06	-5.82	16.10
9	1	0.00	-1.37	3.31	-7.19	17.47
10	1	0.00	-1.63	3.58	-8.56	18.84

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W6, TC03, crack in .071" strap @ 16,500 lbs (Title)
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	0.59	1.37	3.08	7.19
2	1	2.29	0.33	1.63	1.71	8.56
3	1	1.14	0.20	1.76	1.03	9.25
4	1	0.23	-0.07	2.02	-0.34	10.62
5	1	0.04	-0.33	2.27	-1.71	11.99
6	1	0.01	-0.58	2.54	-3.08	13.36
7	1	0.00	-0.84	2.79	-4.45	14.73
8	1	0.00	-1.11	3.06	-5.82	16.10
9	1	0.00	-1.37	3.31	-7.19	17.47
10	1	0.00	-1.63	3.58	-8.56	18.84

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W6, TC03, crack in .071" strap @ 16,500 lbs (Title)
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)

1	1	38.29	0.59	1.37	3.08	7.19
2	1	4.57	0.33	1.63	1.71	8.56
3	1	2.29	0.20	1.76	1.03	9.25
4	1	0.46	-0.07	2.02	-0.34	10.62
5	1	0.08	-0.33	2.27	-1.71	11.99
6	1	0.02	-0.58	2.54	-3.08	13.36
7	1	0.01	-0.84	2.79	-4.45	14.73
8	1	0.00	-1.11	3.06	-5.82	16.10
9	1	0.00	-1.37	3.31	-7.19	17.47
10	1	0.00	-1.63	3.58	-8.56	18.84

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W6, TC03, crack in .071" strap @ 16,500 lbs (Title)
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	0.58	0.59	3.07	3.10
2	1	0.44	0.46	0.64	2.46	3.38
3	1	0.22	0.35	0.70	1.84	3.68
4	1	0.06	0.23	0.75	1.23	3.99
5	1	0.00	0.12	0.81	0.61	4.30
6	1	0.00	0.00	0.87	0.00	4.60

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W6, TC03, crack in .071" strap @ 16,500 lbs (Title)
MODEL: TC03

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
500	15		0.050282	1.707827
1000	15		0.050564	1.707714
1500	15		0.050846	1.707601
2000	15		0.051128	1.707485
2500	15		0.051408	1.707369
3000	15		0.051689	1.707251
3500	15		0.051969	1.707133
4000	15		0.052249	1.707013
4500	15		0.052529	1.706893
5000	15		0.052808	1.706772
5500	15		0.053087	1.706651
6000	15		0.053365	1.706530
6500	15		0.053644	1.706408
7000	15		0.053921	1.706286
7500	15		0.054199	1.706163
8000	15		0.054476	1.706041
8500	15		0.054753	1.705919
9000	15		0.055029	1.705798
9500	15		0.055306	1.705676
10000	15		0.055581	1.705555
10500	15		0.055857	1.705435
11000	15		0.056132	1.705315
11500	15		0.056407	1.705195

12000	15	0.056681	1.705076
12500	15	0.056955	1.704959
13000	15	0.057229	1.704841
13500	15	0.057503	1.704725
14000	15	0.057776	1.704610
14500	15	0.058049	1.704496
15000	15	0.058321	1.704383
15500	15	0.058594	1.704271
16000	15	0.058866	1.704160
16500	15	0.059137	1.704051
17000	15	0.059409	1.703943
17500	15	0.059680	1.703836
18000	15	0.059951	1.703731
18500	15	0.060221	1.703627
19000	15	0.060491	1.703525
19500	15	0.060761	1.703424
20000	15	0.061031	1.703325
20500	15	0.061300	1.703228
21000	15	0.061569	1.703132
21500	15	0.061838	1.703038
22000	15	0.062107	1.702946
22500	15	0.062375	1.702856
23000	15	0.062643	1.702767
23500	15	0.062911	1.702681
24000	15	0.063179	1.702596
24500	15	0.063446	1.702513
25000	15	0.063713	1.702432

PSE-W6, TC03, crack in .071" strap @ 16,500 lbs (Title)
MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
25500	15		0.063980	1.702354
26000	15		0.064246	1.702277
26500	15		0.064513	1.702202
27000	15		0.064779	1.702130
27500	15		0.065045	1.702059
28000	15		0.065310	1.701991
28500	15		0.065576	1.701925
29000	15		0.065841	1.701861
29500	15		0.066106	1.701799
30000	15		0.066371	1.701740
30500	15		0.066635	1.701683
31000	15		0.066900	1.701628
31500	15		0.067164	1.701576
32000	15		0.067428	1.701525
32500	15		0.067692	1.701477
33000	15		0.067955	1.701432
33500	15		0.068219	1.701389
34000	15		0.068482	1.701348
34500	15		0.068745	1.701310
35000	15		0.069008	1.701274
35500	15		0.069271	1.701241
36000	15		0.069534	1.701210
36500	15		0.069796	1.701182
37000	15		0.070058	1.701156
37500	15		0.070320	1.701132
38000	15		0.070582	1.701111
38500	15		0.070844	1.701093
39000	15		0.071106	1.701077
39500	15		0.071368	1.701064
40000	15		0.071629	1.701054
40500	15		0.071890	1.701046
41000	15		0.072151	1.701041
41500	15		0.072413	1.701038

42000	15	0.072674	1.701038
42500	15	0.072934	1.701040
43000	15	0.073195	1.701046
43500	15	0.073456	1.701054
44000	15	0.073716	1.701064
44500	15	0.073977	1.701078
45000	15	0.074237	1.701094
45500	15	0.074497	1.701113
46000	15	0.074757	1.701134
46500	15	0.075018	1.701158
47000	15	0.075278	1.701185
47500	15	0.075538	1.701215
48000	15	0.075797	1.701248
48500	15	0.076057	1.701283
49000	15	0.076317	1.701321
49500	15	0.076577	1.701362
50000	15	0.076836	1.701406

PSE-W6, TC03, crack in .071" strap @ 16,500 lbs (Title)
MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
50500	15		0.077096	1.701452
51000	15		0.077356	1.701502
51500	15		0.077615	1.701554
52000	15		0.077875	1.701609
52500	15		0.078134	1.701667
53000	15		0.078394	1.701728
53500	15		0.078653	1.701791
54000	15		0.078912	1.701858
54500	15		0.079172	1.701927
55000	15		0.079431	1.702000
55500	15		0.079691	1.702075
56000	15		0.079950	1.702153
56500	15		0.080209	1.702235
57000	15		0.080469	1.702319
57500	15		0.080728	1.702406
58000	15		0.080988	1.702496
58500	15		0.081247	1.702589
59000	15		0.081506	1.702685
59500	15		0.081766	1.702784
60000	15		0.082026	1.702886
60500	15		0.082285	1.702991
61000	15		0.082545	1.703099
61500	15		0.082804	1.703210
62000	15		0.083064	1.703324
62500	15		0.083324	1.703441
63000	15		0.083584	1.703561
63500	15		0.083844	1.703684
64000	15		0.084104	1.703811
64500	15		0.084364	1.703940
65000	15		0.084624	1.704073
65500	15		0.084884	1.704209
66000	15		0.085144	1.704347
66500	15		0.085405	1.704489
67000	15		0.085665	1.704634
67500	15		0.085926	1.704783
68000	15		0.086186	1.704934
68500	15		0.086447	1.705089
69000	15		0.086708	1.705247
69500	15		0.086969	1.705408
70000	15		0.087230	1.705572
70500	15		0.087492	1.705739
71000	15		0.087753	1.705910
71500	15		0.088015	1.706084

72000	15	0.088276	1.706261
72500	15	0.088538	1.706442
73000	15	0.088800	1.706626
73500	15	0.089062	1.706813
74000	15	0.089324	1.707003
74500	15	0.089587	1.707197
75000	15	0.089850	1.707394

PSE-W6, TC03, crack in .071" strap @ 16,500 lbs (Title)
MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
75500	15		0.090112	1.707595
76000	15		0.090375	1.707799
76500	15		0.090638	1.708006
77000	15		0.090902	1.708217
77500	15		0.091165	1.708431
78000	15		0.091429	1.708648
78500	15		0.091693	1.708869
79000	15		0.091957	1.709094
79500	15		0.092221	1.709322
80000	15		0.092486	1.709553

FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No. 0.00 of Load Step No. 6
Step description:
of Block No. 15 of Schedule No. 80000
Crack Size c = 0.924860E-01

C-7 PSE W7 SA227 Lower Wing Skin FWD Side MLG Trunnion at WS 113

FATIGUE CRACK GROWTH ANALYSIS

DATE: 09/30/98 TIME: 08:17:24
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

THROUGH CRACK CASE 3, PSE-W7 hole crack in T-stringer

GEOMETRY

MODEL: TC03-Through crack from hole in plate.

```
Plate Thickness, t =    0.0630
  "   Width, W     =    0.7500
Hole Diameter, D   =    0.1600
Hole-Center-to-Edge Dist., B =    0.3440
```

FLAW SIZE:

c (init.) = 0.5000E-01

MATERIAL

MATL 1:
1 2014T6511 EXTRUSION T-L

Material Properties:

Matl No.	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	74.0	65.0	27.0	27.0	1.00	1.00	0.063	53.4	

Matl No.	C	n	p	q	DKo	Rcl	Alpha	Smax/SIGo
	Crack Growth Eqn Constants							
1	0.200E-08	3.700	0.50	1.00	2.70	0.70	5.84	1.00

THROUGH CRACK CASE 3, PSE-W7 hole crack in T-stringer
MODEL: TC03

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0: -3.2200
Scale Factor for Stress S3: -3.6600

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 5.9500
Scale Factor for Stress S3: 6.7600

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 5.9500
Scale Factor for Stress S3: 6.7600

C-7 PSE W7 SA227 Lower Wing Skin FWD Side MLG Trunnion at WS 113 (Continued)

```
Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    5.9500
Scale Factor for Stress S3:    6.7600

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.7000
Scale Factor for Stress S3:    4.2000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                   Block Case No.
From   -   To
   1   -    1                         1
   2   -    2                         2
   3   -    3                         5
   4   -    4                         1
   5   -    5                         3
   6   -    6                         5
   7   -    7                         1
   8   -    8                         3
   9   -    9                         5
  10   -   10                         1
  11   -   11                         3
  12   -   12                         5
  13   -   13                         1
  14   -   14                         4
  15   -   15                         5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :        S0          :        S3          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        1.90 :    0.70:     1.30:    0.70:     1.30:
   2: 1:        0.09 :    0.60:     1.40:    0.60:     1.40:
   3: 1:        0.01 :    0.54:     1.46:    0.54:     1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER      :        S0          :        S3          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        0.00 :    1.06:     1.08:    1.06:     1.08:
   2: 1:       15.09 :    0.85:     1.29:    0.85:     1.29:
   3: 1:        1.52 :    0.64:     1.50:    0.64:     1.50:
   4: 1:        0.23 :    0.42:     1.72:    0.42:     1.72:
   5: 1:        0.05 :    0.20:     1.94:    0.20:     1.94:
   6: 1:        0.01 :   -0.01:     2.15:   -0.01:     2.15:
   7: 1:        0.00 :   -0.23:     2.37:   -0.23:     2.37:
   8: 1:        0.00 :   -0.45:     2.59:   -0.45:     2.59:
   9: 1:        0.00 :   -0.66:     2.80:   -0.66:     2.80:
  10: 1:        0.00 :   -0.88:     3.02:   -0.88:     3.02:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S  : M:  NUMBER      :        S0          :        S3          :
```

TEP	ATL	OF FATIGUE CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	0.00	1.06	1.08	1.06	1.08
2	1	31.10	0.85	1.29	0.85	1.29
3	1	2.98	0.64	1.50	0.64	1.50
4	1	0.45	0.42	1.72	0.42	1.72
5	1	0.09	0.20	1.94	0.20	1.94
6	1	0.02	-0.01	2.15	-0.01	2.15
7	1	0.01	-0.23	2.37	-0.23	2.37
8	1	0.00	-0.45	2.59	-0.45	2.59
9	1	0.00	-0.66	2.80	-0.66	2.80
10	1	0.00	-0.88	3.02	-0.88	3.02

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	1.06	1.08	1.06	1.08
2	1	24.52	0.85	1.29	0.85	1.29
3	1	2.73	0.64	1.50	0.64	1.50
4	1	0.46	0.42	1.72	0.42	1.72
5	1	0.11	0.20	1.94	0.20	1.94
6	1	0.03	-0.01	2.15	-0.01	2.15
7	1	0.01	-0.23	2.37	-0.23	2.37
8	1	0.00	-0.45	2.59	-0.45	2.59
9	1	0.00	-0.66	2.80	-0.66	2.80
10	1	0.00	-0.88	3.02	-0.88	3.02

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W7 hole crack in T-stringer
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	-2.25	-4.19	-2.56	-4.76
2	1	0.09	-1.93	-4.51	-2.20	-5.12

3	1	0.01	-1.74	-4.70	-1.98	-5.34

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W7 hole crack in T-stringer
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.00	6.31	6.43	7.17	7.30
2	1	15.09	5.06	7.68	5.75	8.72
3	1	1.52	3.81	8.93	4.33	10.14
4	1	0.23	2.50	10.23	2.84	11.63
5	1	0.05	1.19	11.54	1.35	13.11
6	1	0.01	-0.06	12.79	-0.07	14.53
7	1	0.00	-1.37	14.10	-1.55	16.02
8	1	0.00	-2.68	15.41	-3.04	17.51
9	1	0.00	-3.93	16.66	-4.46	18.93
10	1	0.00	-5.24	17.97	-5.95	20.42

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W7 hole crack in T-stringer
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.00	6.31	6.43	7.17	7.30
2	1	31.10	5.06	7.68	5.75	8.72
3	1	2.98	3.81	8.93	4.33	10.14
4	1	0.45	2.50	10.23	2.84	11.63
5	1	0.09	1.19	11.54	1.35	13.11
6	1	0.02	-0.06	12.79	-0.07	14.53
7	1	0.01	-1.37	14.10	-1.55	16.02
8	1	0.00	-2.68	15.41	-3.04	17.51
9	1	0.00	-3.93	16.66	-4.46	18.93
10	1	0.00	-5.24	17.97	-5.95	20.42

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W7 hole crack in T-stringer
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.00	6.31	6.43	7.17	7.30
2	1	24.52	5.06	7.68	5.75	8.72
3	1	2.73	3.81	8.93	4.33	10.14

C-7 PSE W7 SA227 Lower Wing Skin FWD Side MLG Trunnion at WS 113 (Continued)

4:	1:	0.46 :	2.50:	10.23:	2.84:	11.63:
5:	1:	0.11 :	1.19:	11.54:	1.35:	13.11:
6:	1:	0.03 :	-0.06:	12.79:	-0.07:	14.53:
7:	1:	0.01 :	-1.37:	14.10:	-1.55:	16.02:
8:	1:	0.00 :	-2.68:	15.41:	-3.04:	17.51:
9:	1:	0.00 :	-3.93:	16.66:	-4.46:	18.93:
10:	1:	0.00 :	-5.24:	17.97:	-5.95:	20.42:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W7 hole crack in T-stringer
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.28 :	3.70:	3.74:	4.20:	4.24:
2:	1:	0.44 :	3.00:	3.92:	3.40:	4.45:
3:	1:	0.22 :	2.29:	4.14:	2.60:	4.70:
4:	1:	0.06 :	1.59:	4.37:	1.76:	4.96:
5:	1:	0.00 :	0.85:	4.59:	0.97:	5.21:
6:	1:	0.00 :	0.15:	4.81:	0.17:	5.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W7 hole crack in T-stringer
MODEL: TC03

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.055120	4.357180
400	15		0.060385	4.388155
600	15		0.065809	4.421823
800	15		0.071415	4.459244
1000	15		0.077230	4.501426
1200	15		0.083290	4.549450
1400	15		0.089639	4.604580
1600	15		0.096337	4.668418
1800	15		0.103458	4.743116
2000	15		0.111105	4.831730
2200	15		0.119420	4.938839
2400	15		0.128613	5.071767
2600	15		0.139018	5.243292
2800	15		0.151219	5.478653
3000	15		0.166435	5.838901

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No. 10
Step description:
of Block No. 2 of Schedule No. 3048
Crack Size c = 0.170731

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)

at the very beginning of Load Step No. 10
Step description:
of Block No. 5 of Schedule No. 3124
Crack Size c = 0.178593

FATIGUE CRACK GROWTH ANALYSIS
-------Modified by FAI-------
DATE: 28-APR-99 TIME: 14:01:57
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

THROUGH CRACK CASE 3, PSE-W7 skin after stringer breaks

GEOMETRY

MODEL: TC03-Through crack from hole in plate.

Plate Thickness, t = 0.0320
" Width, W = 14.0000
Hole Diameter, D = 0.1600
Hole-Center-to-Edge Dist., B = 7.0000

FLAW SIZE:

c (init.) = 0.5000E-01

MATERIAL

MATL 1: 2024-T3
Clad Plt & Sht; L-T; LA & HHA

Material Properties:

Matl No.	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	66.0	53.0	46.0	33.0	1.00	1.00	0.032	66.0	

Matl No.	C	n	p	q	DKo	Rcl	Alpha	Smax/ SIGo
	---------- Crack Growth Eqn Constants -------------							
1	0.829D-08	3.284	0.50	1.00	2.90	0.70	1.50	0.30

MODEL: TC03

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0: -5.0000
Scale Factor for Stress S3: -5.0000

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 5.1000
Scale Factor for Stress S3: 18.770

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 5.1000
Scale Factor for Stress S3: 18.770

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 5.1000
Scale Factor for Stress S3: 18.770

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 3.1700
Scale Factor for Stress S3: 11.670

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	1.06	1.08	1.06	1.08
2	1	15.09	0.85	1.29	0.85	1.29
3	1	1.52	0.64	1.50	0.64	1.50
4	1	0.23	0.42	1.72	0.42	1.72
5	1	0.05	0.20	1.94	0.20	1.94
6	1	0.01	-0.01	2.15	-0.01	2.15
7	1	0.00	-0.23	2.37	-0.23	2.37
8	1	0.00	-0.45	2.59	-0.45	2.59
9	1	0.00	-0.66	2.80	-0.66	2.80
10	1	0.00	-0.88	3.02	-0.88	3.02

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	1.06	1.08	1.06	1.08
2	1	31.10	0.85	1.29	0.85	1.29
3	1	2.98	0.64	1.50	0.64	1.50
4	1	0.45	0.42	1.72	0.42	1.72
5	1	0.09	0.20	1.94	0.20	1.94
6	1	0.02	-0.01	2.15	-0.01	2.15
7	1	0.01	-0.23	2.37	-0.23	2.37
8	1	0.00	-0.45	2.59	-0.45	2.59
9	1	0.00	-0.66	2.80	-0.66	2.80
10	1	0.00	-0.88	3.02	-0.88	3.02

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	1.06	1.08	1.06	1.08
2	1	24.52	0.85	1.29	0.85	1.29
3	1	2.73	0.64	1.50	0.64	1.50
4	1	0.46	0.42	1.72	0.42	1.72
5	1	0.11	0.20	1.94	0.20	1.94
6	1	0.03	-0.01	2.15	-0.01	2.15
7	1	0.01	-0.23	2.37	-0.23	2.37
8	1	0.00	-0.45	2.59	-0.45	2.59
9	1	0.00	-0.66	2.80	-0.66	2.80
10	1	0.00	-0.88	3.02	-0.88	3.02

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.06	0.81	1.06
3	1	0.22	0.62	1.12	0.62	1.12
4	1	0.06	0.43	1.18	0.42	1.18
5	1	0.00	0.23	1.24	0.23	1.24
6	1	0.00	0.04	1.30	0.04	1.30

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S T E	M A T	NUMBER OF FATIGUE	S0 (ksi)	S3 (ksi)

C-7 PSE W7 SA227 Lower Wing Skin FWD Side MLG Trunnion at WS 113 (Continued)

P	L: CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1: 1.90	-3.50:	-6.50:	-3.50:	-6.50:
2:	1: 0.09	-3.00:	-7.00:	-3.00:	-7.00:
3:	1: 0.01	-2.70:	-7.30:	-2.70:	-7.30:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.00	5.41:	5.51:	19.90:	20.27:
2:	1:	15.09	4.33:	6.58:	15.95:	24.21:
3:	1:	1.52	3.26:	7.65:	12.01:	28.16:
4:	1:	0.23	2.14:	8.77:	7.88:	32.28:
5:	1:	0.05	1.02:	9.89:	3.75:	36.41:
6:	1:	0.01	-0.05:	10.97:	-0.19:	40.36:
7:	1:	0.00	-1.17:	12.09:	-4.32:	44.48:
8:	1:	0.00	-2.29:	13.21:	-8.45:	48.61:
9:	1:	0.00	-3.37:	14.28:	-12.39:	52.56:
10:	1:	0.00	-4.49:	15.40:	-16.52:	56.69:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.00	5.41:	5.51:	19.90:	20.27:
2:	1:	31.10	4.33:	6.58:	15.95:	24.21:
3:	1:	2.98	3.26:	7.65:	12.01:	28.16:
4:	1:	0.45	2.14:	8.77:	7.88:	32.28:
5:	1:	0.09	1.02:	9.89:	3.75:	36.41:
6:	1:	0.02	-0.05:	10.97:	-0.19:	40.36:
7:	1:	0.01	-1.17:	12.09:	-4.32:	44.48:
8:	1:	0.00	-2.29:	13.21:	-8.45:	48.61:
9:	1:	0.00	-3.37:	14.28:	-12.39:	52.56:
10:	1:	0.00	-4.49:	15.40:	-16.52:	56.69:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)

1:	1:	0.00 :	5.41:	5.51:	19.90:	20.27:
2:	1:	24.52 :	4.33:	6.58:	15.95:	24.21:
3:	1:	2.73 :	3.26:	7.65:	12.01:	28.16:
4:	1:	0.46 :	2.14:	8.77:	7.88:	32.28:
5:	1:	0.11 :	1.02:	9.89:	3.75:	36.41:
6:	1:	0.03 :	-0.05:	10.97:	-0.19:	40.36:
7:	1:	0.01 :	-1.17:	12.09:	-4.32:	44.48:
8:	1:	0.00 :	-2.29:	13.21:	-8.45:	48.61:
9:	1:	0.00 :	-3.37:	14.28:	-12.39:	52.56:
10:	1:	0.00 :	-4.49:	15.40:	-16.52:	56.69:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.28 :	3.17:	3.20:	11.67:	11.79:
2:	1:	0.44 :	2.57:	3.36:	9.45:	12.37:
3:	1:	0.22 :	1.97:	3.55:	7.24:	13.07:
4:	1:	0.06 :	1.36:	3.74:	4.90:	13.77:
5:	1:	0.00 :	0.73:	3.93:	2.68:	14.47:
6:	1:	0.00 :	0.13:	4.12:	0.47:	15.17:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-W
MODEL: TC03

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.054993	4.420128
400	15		0.059837	4.387497
600	15		0.064548	4.357748
800	15		0.069141	4.330842
1000	15		0.073628	4.306614
1200	15		0.078022	4.284849
1400	15		0.082335	4.265323
1600	15		0.086574	4.247823
1800	15		0.090749	4.232153
2000	15		0.094866	4.218137
2200	15		0.098933	4.205617
2400	15		0.102955	4.194456
2600	15		0.106938	4.184529
2800	15		0.110885	4.175731
3000	15		0.114801	4.167965
3200	15		0.118691	4.161147
3400	15		0.122556	4.155203
3600	15		0.126401	4.150066
3800	15		0.130229	4.145678
4000	15		0.134041	4.141986
4200	15		0.137841	4.138942
4400	15		0.141631	4.136505
4600	15		0.145413	4.134637

4800	15	0.149188	4.133303
5000	15	0.152959	4.132474
5200	15	0.156728	4.132120
5400	15	0.160495	4.132216
5600	15	0.164263	4.132740
5800	15	0.168034	4.133671
6000	15	0.171808	4.134988
6200	15	0.175586	4.136676
6400	15	0.179371	4.138718
6600	15	0.183164	4.141099
6800	15	0.186965	4.143805
7000	15	0.190776	4.146826
7200	15	0.194597	4.150148
7400	15	0.198431	4.153762
7600	15	0.202278	4.157658
7800	15	0.206139	4.161827
8000	15	0.210015	4.166261
8200	15	0.213907	4.170953
8400	15	0.217816	4.175895
8600	15	0.221743	4.181081
8800	15	0.225689	4.186506
9000	15	0.229655	4.192162
9200	15	0.233642	4.198047
9400	15	0.237650	4.204154
9600	15	0.241681	4.210479
9800	15	0.245735	4.217019
10000	15	0.249814	4.223770

MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
10200	15		0.253918	4.230729
10400	15		0.258049	4.237891
10600	15		0.262206	4.245256
10800	15		0.266391	4.252819
11000	15		0.270605	4.260578
11200	15		0.274849	4.268532
11400	15		0.279123	4.276679
11600	15		0.283429	4.285016
11800	15		0.287767	4.293543
12000	15		0.292139	4.302257
12200	15		0.296545	4.311157
12400	15		0.300986	4.320244
12600	15		0.305462	4.329514
12800	15		0.309976	4.338968
13000	15		0.314528	4.348606
13200	15		0.319119	4.358426
13400	15		0.323750	4.368428
13600	15		0.328421	4.378612
13800	15		0.333134	4.388978
14000	15		0.337891	4.399526
14200	15		0.342691	4.410256
14400	15		0.347536	4.421168
14600	15		0.352427	4.432262
14800	15		0.357366	4.443539
15000	15		0.362352	4.455000
15200	15		0.367388	4.466644
15400	15		0.372475	4.478474
15600	15		0.377613	4.490488
15800	15		0.382803	4.502689
16000	15		0.388048	4.515078
16200	15		0.393349	4.527655
16400	15		0.398705	4.540422
16600	15		0.404120	4.553380

16800	15	0.409594	4.566530
17000	15	0.415128	4.579874
17200	15	0.420724	4.593414
17400	15	0.426383	4.607151
17600	15	0.432107	4.621086
17800	15	0.437897	4.635222
18000	15	0.443755	4.649561
18200	15	0.449682	4.664104
18400	15	0.455680	4.678855
18600	15	0.461750	4.693814
18800	15	0.467894	4.708984
19000	15	0.474114	4.724368
19200	15	0.480411	4.739968
19400	15	0.486788	4.755787
19600	15	0.493245	4.771828
19800	15	0.499786	4.788093
20000	15	0.506412	4.804585

MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block Step	Final Flaw Size c	K max c-tip
20200	15	0.513124	4.821308
20400	15	0.519926	4.838264
20600	15	0.526818	4.855456
20800	15	0.533804	4.872889
21000	15	0.540885	4.890566
21200	15	0.548064	4.908489
21400	15	0.555342	4.926664
21600	15	0.562724	4.945094
21800	15	0.570210	4.963782
22000	15	0.577803	4.982733
22200	15	0.585507	5.001952
22400	15	0.593323	5.021443
22600	15	0.601255	5.041210
22800	15	0.609305	5.061258
23000	15	0.617477	5.081592
23200	15	0.625774	5.102217
23400	15	0.634198	5.123139
23600	15	0.642753	5.144362
23800	15	0.651442	5.165892
24000	15	0.660269	5.187736
24200	15	0.669238	5.209899
24400	15	0.678351	5.232387
24600	15	0.687614	5.255208
24800	15	0.697029	5.278366
25000	15	0.706602	5.301870
25200	15	0.716336	5.325727
25400	15	0.726235	5.349943
25600	15	0.736305	5.374526
25800	15	0.746550	5.399485
26000	15	0.756975	5.424828
26200	15	0.767584	5.450563
26400	15	0.778384	5.476698
26600	15	0.789380	5.503243
26800	15	0.800577	5.530208
27000	15	0.811982	5.557603
27200	15	0.823600	5.585436
27400	15	0.835438	5.613720
27600	15	0.847502	5.642466
27800	15	0.859800	5.671685
28000	15	0.872339	5.701388
28200	15	0.885125	5.731588
28400	15	0.898168	5.762299
28600	15	0.911474	5.793532

28800	15	0.925053	5.825303
29000	15	0.938913	5.857626
29200	15	0.953063	5.890516
29400	15	0.967513	5.923989
29600	15	0.982273	5.958062
29800	15	0.997354	5.992751
30000	15	1.012767	6.028075

MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block Step	Final Flaw Size c	K max c-tip
30200	15	1.028522	6.064054
30400	15	1.044632	6.100706
30600	15	1.061110	6.138053
30800	15	1.077969	6.176116
31000	15	1.095223	6.214918
31200	15	1.112886	6.254483
31400	15	1.130973	6.294837
31600	15	1.149502	6.336005
31800	15	1.168488	6.378017
32000	15	1.187950	6.420900
32200	15	1.207907	6.464687
32400	15	1.228377	6.509411
32600	15	1.249384	6.555105
32800	15	1.270948	6.601806
33000	15	1.293093	6.649554
33200	15	1.315843	6.698390
33400	15	1.339227	6.748357
33600	15	1.363270	6.799502
33800	15	1.388004	6.851874
34000	15	1.413460	6.905528
34200	15	1.439671	6.960519
34400	15	1.466674	7.016907
34600	15	1.494506	7.074759
34800	15	1.523210	7.134143
35000	15	1.552828	7.195134
35200	15	1.583409	7.257814
35400	15	1.615004	7.322270
35600	15	1.647666	7.388596
35800	15	1.681454	7.456897
36000	15	1.716434	7.527282
36200	15	1.752673	7.599875
36400	15	1.790246	7.674810
36600	15	1.829236	7.752232
36800	15	1.869731	7.832305
37000	15	1.911828	7.915207
37200	15	1.955635	8.001135
37400	15	2.001269	8.090313
37600	15	2.048860	8.182986
37800	15	2.098552	8.279434
38000	15	2.150505	8.379970
38200	15	2.204898	8.484954
38400	15	2.261933	8.594793
38600	15	2.321837	8.709959
38800	15	2.384867	8.830999
39000	15	2.451320	8.958551
39200	15	2.521535	9.093369
39400	15	2.595906	9.236353
39600	15	2.674895	9.388586
39800	15	2.759049	9.551390
40000	15	2.849022	9.726406

MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
40200	15		2.945609	9.915700
40400	15		3.049789	10.121925
40600	15		3.162796	10.348573
40800	15		3.286214	10.600361
41000	15		3.422138	10.883885
41200	15		3.573440	11.208759
41400	15		3.744235	11.589779
41600	15		3.940789	12.051417
41800	15		4.173502	12.638506
42000	15		4.462080	13.447203
42200	15		4.853850	14.751312

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     65.98      K ref =     0.000      K cr =     65.96
at Cycle No.           0.00   of Load Step No.    10
Step description:
of Block No.       5   of Schedule No.    42382
Crack Size       c =   5.46765
```

C-8 PSE W8 Chordwise Skin Splice at WS 173.944

FATIGUE CRACK GROWTH ANALYSIS

DATE: 09/18/98 TIME: 08:29:40
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

THROUGH CRACK CASE 5, PSE-W8 hole crack in .025 skin

GEOMETRY

MODEL: TC05-Through crack from hole in row of holes.

Plate Thickness, t = 0.0250
Hole Dia., D = 0.1300
Hole-to-Hole Dist., H = 0.6250
Dia./Edge-Dist. Ratio, D/B = 0.0000
(D/B = 0 means B is very large)

FLAW SIZE:

c (init.) = 0.5000E-01

MATERIAL

MATL 1: 2024-T3
Clad Plt & Sht; L-T; LA & HHA

Material Properties:

Matl No.	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	66.0	53.0	46.0	33.0	1.00	1.00	0.025	66.0	

Matl No.	Crack Growth Eqn Constants							
	C	n	p	q	DKo	Rcl	Alpha	Smax/SIGo
1	0.829E-08	3.284	0.50	1.00	2.90	0.70	1.50	0.30

THROUGH CRACK CASE 5, PSE-W8 hole crack in .025 skin
MODEL: TC05

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0: -0.48000
Scale Factor for Stress S3: -2.6000
Scale Factor for Stress S4: 0.00000

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 2.5300
Scale Factor for Stress S3: 13.700
Scale Factor for Stress S4: 0.00000

C-8 PSE W8 Chordwise Skin Slice at WS 173.944 (Continued)

```
Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    2.5300
Scale Factor for Stress S3:    13.700
Scale Factor for Stress S4:   0.00000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    2.5300
Scale Factor for Stress S3:    13.700
Scale Factor for Stress S4:   0.00000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    1.3400
Scale Factor for Stress S3:    7.2800
Scale Factor for Stress S4:   0.00000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                       Block Case No.
From    -   To
   1    -     1                          1
   2    -     2                          2
   3    -     3                          5
   4    -     4                          1
   5    -     5                          3
   6    -     6                          5
   7    -     7                          1
   8    -     8                          3
   9    -     9                          5
  10    -    10                          1
  11    -    11                          3
  12    -    12                          5
  13    -    13                          1
  14    -    14                          4
  15    -    15                          5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :        S0         :       S3         :
 T  : A:    OF        :                   :                  :
 E  : T:  FATIGUE     :                   :                  :
 P  : L:  CYCLES      :    (t1) :  (t2)   :   (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.90 :    0.70:     1.30:    0.70:     1.30:
   2: 1:        0.09 :    0.60:     1.40:    0.60:     1.40:
   3: 1:        0.01 :    0.54:     1.46:    0.54:     1.46:
 S  : M:  NUMBER      :        S4         :       S          :
 T  : A:    OF        :                   :                  :
 E  : T:  FATIGUE     :                   :                  :
 P  : L:  CYCLES      :    (t1) :  (t2)   :   (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.90 :    0.70:     1.30:    0.00:     0.00:
   2: 1:        0.09 :    0.60:     1.40:    0.00:     0.00:
   3: 1:        0.01 :    0.54:     1.46:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER      :        S0         :       S3         :
 T  : A:    OF        :                   :                  :
 E  : T:  FATIGUE     :                   :                  :
 P  : L:  CYCLES      :    (t1) :  (t2)   :   (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
```

C-8 PSE W8 Chordwise Skin Slice at WS 173.944 (Continued)

```
   1: 1:        9.57 :    0.64:     1.24:     0.64:     1.24:
   2: 1:        1.14 :    0.44:     1.44:     0.44:     1.44:
   3: 1:        0.57 :    0.34:     1.54:     0.34:     1.54:
   4: 1:        0.11 :    0.14:     1.74:     0.14:     1.74:
   5: 1:        0.02 :   -0.06:     1.94:    -0.06:     1.94:
   6: 1:        0.01 :   -0.26:     2.14:    -0.26:     2.14:
   7: 1:        0.00 :   -0.46:     2.34:    -0.46:     2.34:
   8: 1:        0.00 :   -0.66:     2.54:    -0.66:     2.54:
   9: 1:        0.00 :   -0.86:     2.74:    -0.86:     2.74:
  10: 1:        0.00 :   -1.06:     2.94:    -1.06:     2.94:
 S  : M:  NUMBER     :        S4        :        S         :
 T  : A:    OF       :                  :                  :
 E  : T:  FATIGUE    :                  :                  :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)   :
----:--:-------------:---------:--------:---------:--------:
   1: 1:        9.57 :    0.70:     1.30:     0.00:     0.00:
   2: 1:        1.14 :    0.50:     1.50:     0.00:     0.00:
   3: 1:        0.57 :    0.40:     1.60:     0.00:     0.00:
   4: 1:        0.11 :    0.20:     1.80:     0.00:     0.00:
   5: 1:        0.02 :    0.00:     2.00:     0.00:     0.00:
   6: 1:        0.01 :   -0.20:     2.20:     0.00:     0.00:
   7: 1:        0.00 :   -0.40:     2.40:     0.00:     0.00:
   8: 1:        0.00 :   -0.60:     2.60:     0.00:     0.00:
   9: 1:        0.00 :   -0.80:     2.80:     0.00:     0.00:
  10: 1:        0.00 :   -1.00:     3.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S  : M:  NUMBER     :        S0        :        S3        :
 T  : A:    OF       :                  :                  :
 E  : T:  FATIGUE    :                  :                  :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)   :
----:--:-------------:---------:--------:---------:--------:
   1: 1:       19.14 :    0.64:     1.24:     0.64:     1.24:
   2: 1:        2.29 :    0.44:     1.44:     0.44:     1.44:
   3: 1:        1.14 :    0.34:     1.54:     0.34:     1.54:
   4: 1:        0.23 :    0.14:     1.74:     0.14:     1.74:
   5: 1:        0.04 :   -0.06:     1.94:    -0.06:     1.94:
   6: 1:        0.01 :   -0.26:     2.14:    -0.26:     2.14:
   7: 1:        0.00 :   -0.46:     2.34:    -0.46:     2.34:
   8: 1:        0.00 :   -0.66:     2.54:    -0.66:     2.54:
   9: 1:        0.00 :   -0.86:     2.74:    -0.86:     2.74:
  10: 1:        0.00 :   -1.06:     2.94:    -1.06:     2.94:
 S  : M:  NUMBER     :        S4        :        S         :
 T  : A:    OF       :                  :                  :
 E  : T:  FATIGUE    :                  :                  :
 P  : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)   :
----:--:-------------:---------:--------:---------:--------:
   1: 1:       19.14 :    0.70:     1.30:     0.00:     0.00:
   2: 1:        2.29 :    0.50:     1.50:     0.00:     0.00:
   3: 1:        1.14 :    0.40:     1.60:     0.00:     0.00:
   4: 1:        0.23 :    0.20:     1.80:     0.00:     0.00:
   5: 1:        0.04 :    0.00:     2.00:     0.00:     0.00:
   6: 1:        0.01 :   -0.20:     2.20:     0.00:     0.00:
   7: 1:        0.00 :   -0.40:     2.40:     0.00:     0.00:
   8: 1:        0.00 :   -0.60:     2.60:     0.00:     0.00:
   9: 1:        0.00 :   -0.80:     2.80:     0.00:     0.00:
  10: 1:        0.00 :   -1.00:     3.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
```

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	0.64	1.24	0.64	1.24
2	1	4.57	0.44	1.44	0.44	1.44
3	1	2.29	0.34	1.54	0.34	1.54
4	1	0.46	0.14	1.74	0.14	1.74
5	1	0.08	-0.06	1.94	-0.06	1.94
6	1	0.02	-0.26	2.14	-0.26	2.14
7	1	0.01	-0.46	2.34	-0.46	2.34
8	1	0.00	-0.66	2.54	-0.66	2.54
9	1	0.00	-0.86	2.74	-0.86	2.74
10	1	0.00	-1.06	2.94	-1.06	2.94

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	38.29	0.70	1.30	0.00	0.00
2	1	4.57	0.50	1.50	0.00	0.00
3	1	2.29	0.40	1.60	0.00	0.00
4	1	0.46	0.20	1.80	0.00	0.00
5	1	0.08	0.00	2.00	0.00	0.00
6	1	0.02	-0.20	2.20	0.00	0.00
7	1	0.01	-0.40	2.40	0.00	0.00
8	1	0.00	-0.60	2.60	0.00	0.00
9	1	0.00	-0.80	2.80	0.00	0.00
10	1	0.00	-1.00	3.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.79	1.07	0.79	1.07
3	1	0.22	0.59	1.14	0.59	1.14
4	1	0.06	0.38	1.21	0.38	1.21
5	1	0.00	0.17	1.29	0.17	1.29
6	1	0.00	-0.04	1.36	-0.04	1.36

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.01	0.00	0.00
2	1	0.44	0.79	1.07	0.00	0.00
3	1	0.22	0.59	1.14	0.00	0.00
4	1	0.06	0.38	1.21	0.00	0.00
5	1	0.00	0.17	1.29	0.00	0.00
6	1	0.00	-0.04	1.36	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 5, PSE-W8 hole crack in .025 skin
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

C-8 PSE W8 Chordwise Skin Slice at WS 173.944 (Continued)

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	-0.34	-0.62	-1.82	-3.38
2	1	0.09	-0.29	-0.67	-1.56	-3.64
3	1	0.01	-0.26	-0.70	-1.40	-3.80

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 5, PSE-W8 hole crack in .025 skin
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	1.62	3.14	8.77	16.99
2	1	1.14	1.11	3.64	6.03	19.73
3	1	0.57	0.86	3.90	4.66	21.10
4	1	0.11	0.35	4.40	1.92	23.84
5	1	0.02	-0.15	4.91	-0.82	26.58
6	1	0.01	-0.66	5.41	-3.56	29.32
7	1	0.00	-1.16	5.92	-6.30	32.06
8	1	0.00	-1.67	6.43	-9.04	34.80
9	1	0.00	-2.18	6.93	-11.78	37.54
10	1	0.00	-2.68	7.44	-14.52	40.28

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	0.00	0.00	0.00	0.00
2	1	1.14	0.00	0.00	0.00	0.00
3	1	0.57	0.00	0.00	0.00	0.00
4	1	0.11	0.00	0.00	0.00	0.00
5	1	0.02	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 5, PSE-W8 hole crack in .025 skin
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	1.62	3.14	8.77	16.99
2	1	2.29	1.11	3.64	6.03	19.73
3	1	1.14	0.86	3.90	4.66	21.10
4	1	0.23	0.35	4.40	1.92	23.84
5	1	0.04	-0.15	4.91	-0.82	26.58
6	1	0.01	-0.66	5.41	-3.56	29.32
7	1	0.00	-1.16	5.92	-6.30	32.06
8	1	0.00	-1.67	6.43	-9.04	34.80
9	1	0.00	-2.18	6.93	-11.78	37.54
10	1	0.00	-2.68	7.44	-14.52	40.28

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00
2	1	2.29	0.00	0.00	0.00	0.00
3	1	1.14	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.04	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 5, PSE-W8 hole crack in .025 skin
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	1.62	3.14	8.77	16.99
2	1	4.57	1.11	3.64	6.03	19.73
3	1	2.29	0.86	3.90	4.66	21.10
4	1	0.46	0.35	4.40	1.92	23.84
5	1	0.08	-0.15	4.91	-0.82	26.58
6	1	0.02	-0.66	5.41	-3.56	29.32
7	1	0.01	-1.16	5.92	-6.30	32.06
8	1	0.00	-1.67	6.43	-9.04	34.80
9	1	0.00	-2.18	6.93	-11.78	37.54
10	1	0.00	-2.68	7.44	-14.52	40.28

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	38.29	0.00	0.00	0.00	0.00
2	1	4.57	0.00	0.00	0.00	0.00
3	1	2.29	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.08	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00

```
   8: 1:          0.00 :      0.00:      0.00:      0.00:      0.00:
   9: 1:          0.00 :      0.00:      0.00:      0.00:      0.00:
  10: 1:          0.00 :      0.00:      0.00:      0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 THROUGH CRACK CASE 5, PSE-W8 hole crack in .025 skin
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S  : M:  NUMBER      :       S0          :        S3          :
T  : A:    OF        :                   :                    :
E  : T:  FATIGUE     :      (ksi)        :       (ksi)        :
P  : L:  CYCLES      :   (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          0.28 :   1.34:      1.35:      7.28:      7.35:
   2: 1:          0.44 :   1.06:      1.43:      5.75:      7.79:
   3: 1:          0.22 :   0.79:      1.53:      4.30:      8.30:
   4: 1:          0.06 :   0.51:      1.62:      2.77:      8.81:
   5: 1:          0.00 :   0.23:      1.73:      1.24:      9.39:
   6: 1:          0.00 :  -0.05:      1.82:     -0.29:      9.90:
S  : M:  NUMBER      :       S4          :        S           :
T  : A:    OF        :                   :                    :
E  : T:  FATIGUE     :      (ksi)        :       (ksi)        :
P  : L:  CYCLES      :   (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          0.28 :   0.00:      0.00:      0.00:      0.00:
   2: 1:          0.44 :   0.00:      0.00:      0.00:      0.00:
   3: 1:          0.22 :   0.00:      0.00:      0.00:      0.00:
   4: 1:          0.06 :   0.00:      0.00:      0.00:      0.00:
   5: 1:          0.00 :   0.00:      0.00:      0.00:      0.00:
   6: 1:          0.00 :   0.00:      0.00:      0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 THROUGH CRACK CASE 5, PSE-W8 hole crack in .025 skin
MODEL: TC05

ANALYSIS RESULTS:
-----------------


 Schedl    Block          Final Flaw Size            K max
                  Step           c                   c-tip
   1000      15               0.057781             2.604402
   2000      15               0.065485             2.602673
   3000      15               0.073165             2.604257
   4000      15               0.080853             2.606493
   5000      15               0.088554             2.609077
   6000      15               0.096278             2.612200
   7000      15               0.104031             2.615123
   8000      15               0.111811             2.618087
   9000      15               0.119626             2.622151
  10000      15               0.127499             2.628137
  11000      15               0.135460             2.636671
  12000      15               0.143548             2.648219
  13000      15               0.151807             2.663121
  14000      15               0.160289             2.681585
  15000      15               0.169047             2.703674
  16000      15               0.178140             2.729237
  17000      15               0.187623             2.757812
  18000      15               0.197547             2.788462
```

C-8 PSE W8 Chordwise Skin Slice at WS 173.944 (Continued)

19000	15	0.207946	2.819960
20000	15	0.218848	2.852369
21000	15	0.230288	2.886327
22000	15	0.242318	2.922658
23000	15	0.255007	2.962438
24000	15	0.268456	3.007089
25000	15	0.282805	3.058551
26000	15	0.298257	3.119565
27000	15	0.315111	3.194192
28000	15	0.333829	3.288844
29000	15	0.355169	3.414506
30000	15	0.380498	3.592291
31000	15	0.412720	3.880326
32000	15	0.474210	5.620791

FINAL RESULTS:
All Stress Intensities are below the Fatigue Threshold.
NO growth in Schedule No. 32096
Crack Size c = 0.495016

C-9 PSE W10 SA226 and SA227 Skin Splice at WS 27 Inboard

```
                    FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
                DATE: 03-OCT-97   TIME: 08:25:24
         (computed: NASA/FLAGRO Version 2.03, March 1995.)
         U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC5, PSE-W10 crack in .050 skin, outboard sta99 sa226

GEOMETRY
--------
MODEL: TC05-Through crack from hole in row of holes.

Plate Thickness, t =    0.0500
Hole Dia., D       =    0.1900
Hole-to-Hole Dist., H      =    0.6250
Dia./Edge-Dist. Ratio, D/B =    0.0000
(D/B = 0 means B is very large)

FLAW SIZE:

c   (init.) =  0.5000E-01


MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; T-L; LA & HHA

Material Properties:

:Matl:  UTS :  YS  : K1e :  K1c : Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  65.0:  48.0:  41.0:  29.0: 1.00: 1.00:  0.050:  57.9:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.244D-07:2.601:0.50:1.00:  2.90:  0.70: 1.50: 0.30:


MODEL: TC05

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    2.5500
Scale Factor for Stress S3:    11.040
Scale Factor for Stress S4:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    3.7000
Scale Factor for Stress S3:    16.200
Scale Factor for Stress S4:    0.0000
```

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 3.7000
Scale Factor for Stress S3: 16.200
Scale Factor for Stress S4: 0.0000

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 3.7000
Scale Factor for Stress S3: 16.200
Scale Factor for Stress S4: 0.0000

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 1.8000
Scale Factor for Stress S3: 7.9000
Scale Factor for Stress S4: 0.0000

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.46	1.46	0.54	1.46

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	1.90	-0.30	0.30	0.00	0.00
2	1	0.09	-0.40	0.40	0.00	0.00
3	1	0.01	-0.46	0.46	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	9.57	0.40	1.00	0.38	0.98

C-9 PSE W10 SA226 and SA227 Skin Slice at WS 27 Inboard (Continued)

```
  2: 1:        1.14 :    0.20:     1.20:     0.18:     1.18:
  3: 1:        0.57 :    0.10:     1.30:     0.08:     1.28:
  4: 1:        0.11 :   -0.10:     1.50:    -0.12:     1.48:
  5: 1:        0.02 :   -0.30:     1.70:    -0.32:     1.68:
  6: 1:        0.01 :   -0.50:     1.90:    -0.52:     1.88:
  7: 1:        0.00 :   -0.70:     2.10:    -0.72:     2.08:
  8: 1:        0.00 :   -0.90:     2.30:    -0.92:     2.28:
  9: 1:        0.00 :   -1.10:     2.50:    -1.12:     2.48:
 10: 1:        0.00 :   -1.30:     2.70:    -1.32:     2.68:
S   : M:  NUMBER      :        S4         :        S          :
T   : A:    OF        :                   :                   :
E   : T:  FATIGUE     :                   :                   :
P   : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        9.57 :   -0.30:     0.30:     0.00:     0.00:
  2: 1:        1.14 :   -0.50:     0.50:     0.00:     0.00:
  3: 1:        0.57 :   -0.60:     0.60:     0.00:     0.00:
  4: 1:        0.11 :   -0.80:     0.80:     0.00:     0.00:
  5: 1:        0.02 :   -1.00:     1.00:     0.00:     0.00:
  6: 1:        0.01 :   -1.20:     1.20:     0.00:     0.00:
  7: 1:        0.00 :   -1.40:     1.40:     0.00:     0.00:
  8: 1:        0.00 :   -1.60:     1.60:     0.00:     0.00:
  9: 1:        0.00 :   -1.80:     1.80:     0.00:     0.00:
 10: 1:        0.00 :   -2.00:     2.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------


BLOCK CASE NO.  3
S   : M:  NUMBER      :        S0         :        S3         :
T   : A:    OF        :                   :                   :
E   : T:  FATIGUE     :                   :                   :
P   : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
  1: 1:       19.14 :    0.40:     1.00:     0.38:     0.98:
  2: 1:        2.29 :    0.20:     1.20:     0.18:     1.18:
  3: 1:        1.14 :    0.10:     1.30:     0.08:     1.28:
  4: 1:        0.23 :   -0.10:     1.50:    -0.12:     1.48:
  5: 1:        0.04 :   -0.30:     1.70:    -0.32:     1.68:
  6: 1:        0.01 :   -0.50:     1.90:    -0.52:     1.88:
  7: 1:        0.00 :   -0.70:     2.10:    -0.72:     2.08:
  8: 1:        0.00 :   -0.90:     2.30:    -0.92:     2.28:
  9: 1:        0.00 :   -1.10:     2.50:    -1.12:     2.48:
 10: 1:        0.00 :   -1.30:     2.70:    -1.32:     2.68:
S   : M:  NUMBER      :        S4         :        S          :
T   : A:    OF        :                   :                   :
E   : T:  FATIGUE     :                   :                   :
P   : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
  1: 1:       19.14 :   -0.30:     0.30:     0.00:     0.00:
  2: 1:        2.29 :   -0.50:     0.50:     0.00:     0.00:
  3: 1:        1.14 :   -0.60:     0.60:     0.00:     0.00:
  4: 1:        0.23 :   -0.80:     0.80:     0.00:     0.00:
  5: 1:        0.04 :   -1.00:     1.00:     0.00:     0.00:
  6: 1:        0.01 :   -1.20:     1.20:     0.00:     0.00:
  7: 1:        0.00 :   -1.40:     1.40:     0.00:     0.00:
  8: 1:        0.00 :   -1.60:     1.60:     0.00:     0.00:
  9: 1:        0.00 :   -1.80:     1.80:     0.00:     0.00:
 10: 1:        0.00 :   -2.00:     2.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------


BLOCK CASE NO.  4
S   : M:  NUMBER      :        S0         :        S3         :
```

TEP	ATL	OF FATIGUE CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	38.29	0.40	1.00	0.38	0.98
2	1	4.57	0.20	1.20	0.18	1.18
3	1	1.14	0.10	1.30	0.08	1.28
4	1	0.46	-0.10	1.50	-0.12	1.48
5	1	0.08	-0.30	1.70	-0.32	1.68
6	1	0.02	-0.50	1.90	-0.52	1.88
7	1	0.01	-0.70	2.10	-0.72	2.08
8	1	0.00	-0.90	2.30	-0.92	2.28
9	1	0.00	-1.10	2.50	-1.12	2.48
10	1	0.00	-1.30	2.70	-1.32	2.68

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	38.29	-0.30	0.30	0.00	0.00
2	1	4.57	-0.50	0.50	0.00	0.00
3	1	1.14	-0.60	0.60	0.00	0.00
4	1	0.46	-0.80	0.80	0.00	0.00
5	1	0.08	-1.00	1.00	0.00	0.00
6	1	0.02	-1.20	1.20	0.00	0.00
7	1	0.01	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.29	0.81	1.29
3	1	0.22	0.62	1.57	0.62	1.57
4	1	0.06	0.43	1.86	0.43	1.86
5	1	0.00	0.24	2.14	0.24	2.14
6	1	0.00	0.05	2.43	0.05	2.43

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.01	0.00	0.00
2	1	0.44	0.81	1.29	0.00	0.00
3	1	0.22	0.62	1.57	0.00	0.00
4	1	0.06	0.43	1.86	0.00	0.00
5	1	0.00	0.24	2.14	0.00	0.00
6	1	0.00	0.05	2.43	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W10 crack in .050
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	1.78	3.31	7.73	14.35
2	1	0.09	1.53	3.57	6.62	15.46
3	1	0.01	1.17	3.72	5.96	16.12

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W10 crack in .050
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	1.48	3.70	6.16	15.88
2	1	1.14	0.74	4.44	2.92	19.12
3	1	0.57	0.37	4.81	1.30	20.74
4	1	0.11	-0.37	5.55	-1.94	23.98
5	1	0.02	-1.11	6.29	-5.18	27.22
6	1	0.01	-1.85	7.03	-8.42	30.46
7	1	0.00	-2.59	7.77	-11.66	33.70
8	1	0.00	-3.33	8.51	-14.90	36.94
9	1	0.00	-4.07	9.25	-18.14	40.18
10	1	0.00	-4.81	9.99	-21.38	43.42

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	0.00	0.00	0.00	0.00
2	1	1.14	0.00	0.00	0.00	0.00
3	1	0.57	0.00	0.00	0.00	0.00
4	1	0.11	0.00	0.00	0.00	0.00
5	1	0.02	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC5, PSE-W10 crack in .050
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S : M:	NUMBER	S0	S3

```
T   : A:    OF           :                      :                      :
E   : T:  FATIGUE        :       (ksi)          :       (ksi)          :
P   : L:  CYCLES         :   (t1) :   (t2)      :   (t1) :   (t2)      :
----:--:-----------------:---------:------------:---------:------------:
  1: 1:        19.14 :    1.48:      3.70:      6.16:     15.88:
  2: 1:         2.29 :    0.74:      4.44:      2.92:     19.12:
  3: 1:         1.14 :    0.37:      4.81:      1.30:     20.74:
  4: 1:         0.23 :   -0.37:      5.55:     -1.94:     23.98:
  5: 1:         0.04 :   -1.11:      6.29:     -5.18:     27.22:
  6: 1:         0.01 :   -1.85:      7.03:     -8.42:     30.46:
  7: 1:         0.00 :   -2.59:      7.77:    -11.66:     33.70:
  8: 1:         0.00 :   -3.33:      8.51:    -14.90:     36.94:
  9: 1:         0.00 :   -4.07:      9.25:    -18.14:     40.18:
 10: 1:         0.00 :   -4.81:      9.99:    -21.38:     43.42:
S   : M:  NUMBER         :         S4           :          S           :
T   : A:    OF           :                      :                      :
E   : T:  FATIGUE        :       (ksi)          :       (ksi)          :
P   : L:  CYCLES         :   (t1) :   (t2)      :   (t1) :   (t2)      :
----:--:-----------------:---------:------------:---------:------------:
  1: 1:        19.14 :    0.00:      0.00:      0.00:      0.00:
  2: 1:         2.29 :    0.00:      0.00:      0.00:      0.00:
  3: 1:         1.14 :    0.00:      0.00:      0.00:      0.00:
  4: 1:         0.23 :    0.00:      0.00:      0.00:      0.00:
  5: 1:         0.04 :    0.00:      0.00:      0.00:      0.00:
  6: 1:         0.01 :    0.00:      0.00:      0.00:      0.00:
  7: 1:         0.00 :    0.00:      0.00:      0.00:      0.00:
  8: 1:         0.00 :    0.00:      0.00:      0.00:      0.00:
  9: 1:         0.00 :    0.00:      0.00:      0.00:      0.00:
 10: 1:         0.00 :    0.00:      0.00:      0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

TC5, PSE-W10 crack in .050
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER         :         S0           :          S3          :
T   : A:    OF           :                      :                      :
E   : T:  FATIGUE        :       (ksi)          :       (ksi)          :
P   : L:  CYCLES         :   (t1) :   (t2)      :   (t1) :   (t2)      :
----:--:-----------------:---------:------------:---------:------------:
  1: 1:        38.29 :    1.48:      3.70:      6.16:     15.88:
  2: 1:         4.57 :    0.74:      4.44:      2.92:     19.12:
  3: 1:         1.14 :    0.37:      4.81:      1.30:     20.74:
  4: 1:         0.46 :   -0.37:      5.55:     -1.94:     23.98:
  5: 1:         0.08 :   -1.11:      6.29:     -5.18:     27.22:
  6: 1:         0.02 :   -1.85:      7.03:     -8.42:     30.46:
  7: 1:         0.01 :   -2.59:      7.77:    -11.66:     33.70:
  8: 1:         0.00 :   -3.33:      8.51:    -14.90:     36.94:
  9: 1:         0.00 :   -4.07:      9.25:    -18.14:     40.18:
 10: 1:         0.00 :   -4.81:      9.99:    -21.38:     43.42:
S   : M:  NUMBER         :         S4           :          S           :
T   : A:    OF           :                      :                      :
E   : T:  FATIGUE        :       (ksi)          :       (ksi)          :
P   : L:  CYCLES         :   (t1) :   (t2)      :   (t1) :   (t2)      :
----:--:-----------------:---------:------------:---------:------------:
  1: 1:        38.29 :    0.00:      0.00:      0.00:      0.00:
  2: 1:         4.57 :    0.00:      0.00:      0.00:      0.00:
  3: 1:         1.14 :    0.00:      0.00:      0.00:      0.00:
  4: 1:         0.46 :    0.00:      0.00:      0.00:      0.00:
  5: 1:         0.08 :    0.00:      0.00:      0.00:      0.00:
  6: 1:         0.02 :    0.00:      0.00:      0.00:      0.00:
  7: 1:         0.01 :    0.00:      0.00:      0.00:      0.00:
  8: 1:         0.00 :    0.00:      0.00:      0.00:      0.00:
  9: 1:         0.00 :    0.00:      0.00:      0.00:      0.00:
```

C-9 PSE W10 SA226 and SA227 Skin Slice at WS 27 Inboard (Continued)

```
 10: 1:        0.00 :      0.00:      0.00:      0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

TC5, PSE-W10 crack in .050
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
 S  : M:  NUMBER      :         S0          :          S3         :
 T  : A:   OF         :                     :                     :
 E  : T:  FATIGUE     :       (ksi)         :        (ksi)        :
 P  : L:  CYCLES      :    (t1) :  (t2)     :    (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        0.28 :    1.80:      1.82:      7.90:      7.98:
   2: 1:        0.44 :    1.46:      2.32:      6.40:     10.19:
   3: 1:        0.22 :    1.12:      2.83:      4.90:     12.40:
   4: 1:        0.06 :    0.77:      3.35:      3.40:     14.69:
   5: 1:        0.00 :    0.43:      3.85:      1.90:     16.91:
   6: 1:        0.00 :    0.09:      4.37:      0.40:     19.20:
 S  : M:  NUMBER      :         S4          :          S          :
 T  : A:   OF         :                     :                     :
 E  : T:  FATIGUE     :       (ksi)         :        (ksi)        :
 P  : L:  CYCLES      :    (t1) :  (t2)     :    (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        0.28 :    0.00:      0.00:      0.00:      0.00:
   2: 1:        0.44 :    0.00:      0.00:      0.00:      0.00:
   3: 1:        0.22 :    0.00:      0.00:      0.00:      0.00:
   4: 1:        0.06 :    0.00:      0.00:      0.00:      0.00:
   5: 1:        0.00 :    0.00:      0.00:      0.00:      0.00:
   6: 1:        0.00 :    0.00:      0.00:      0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

TC5, PSE-W10 crack in .050
MODEL: TC05

ANALYSIS RESULTS:
-----------------
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
100	15		0.056463	7.685195
200	15		0.063035	7.726431
300	15		0.069703	7.761136
400	15		0.076451	7.790536
500	15		0.083271	7.816528
600	15		0.090153	7.838479
700	15		0.097087	7.856928
800	15		0.104068	7.875091
900	15		0.111101	7.895659
1000	15		0.118195	7.920695
1100	15		0.125367	7.951715
1200	15		0.132636	7.989755
1300	15		0.140024	8.035405
1400	15		0.147556	8.088796
1500	15		0.155255	8.149555
1600	15		0.163145	8.216694
1700	15		0.171248	8.288463
1800	15		0.179576	8.362405
1900	15		0.188139	8.438146
2000	15		0.196950	8.517148

```
   2100        15              0.206027              8.601124
   2200        15              0.215395              8.692059
   2300        15              0.225087              8.792297
   2400        15              0.235150              8.904659
   2500        15              0.245641              9.032628
   2600        15              0.256638              9.180621

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.   10
Step description:
of Block No.      5  of Schedule No.    2683
Crack Size     c =  0.266139
   2700        15              0.268245              9.354453
   2800        15              0.280603              9.562430
   2900        15              0.293910              9.816767
   3000        15              0.308458             10.135925
   3100        15              0.324695             10.549682
   3200        15              0.343365             11.110394

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No.   10
Step description:
of Block No.      5  of Schedule No.    3264
Crack Size     c =  0.357014

                  FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
                DATE: 30-APR-99   TIME: 10:26:56
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 1, PSE-W10 .050 skin, 2 linked holes   (T

GEOMETRY
--------
MODEL: TC01-Through crack in center of plate.

Plate Thickness, t =    0.0500
  "   Width, W     =   24.0000

FLAW SIZE:

c   (init.) =  0.4130



MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  66.0:  53.0:  46.0:  33.0: 1.00: 1.00:  0.050:  65.9:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C    :  n  :  p  :  q :  DKo :  Rcl :Alpha:Smax/:
```

```
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.829D-08:3.284:0.50:1.00:  2.90:  0.70: 1.50: 0.30:
```

MODEL: TC01

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0: 5.8600
Scale Factor for Stress S1: 0.0000

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 8.5600
Scale Factor for Stress S1: 0.0000

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 8.5600
Scale Factor for Stress S1: 0.0000

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 8.5600
Scale Factor for Stress S1: 0.0000

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 4.1700
Scale Factor for Stress S1: 0.0000

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses

C-9 PSE W10 SA226 and SA227 Skin Slice at WS 27 Inboard (Continued)

(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	9.57	0.40	1.00	-0.30	0.30
2	1	1.14	0.20	1.20	-0.50	0.50
3	1	0.57	0.10	1.30	-0.60	0.60
4	1	0.11	-0.10	1.50	-0.80	0.80
5	1	0.02	-0.30	1.70	-1.00	1.00
6	1	0.01	-0.50	1.90	-1.20	1.20
7	1	0.00	-0.70	2.10	-1.40	1.40
8	1	0.00	-0.90	2.30	-1.60	1.60
9	1	0.00	-1.10	2.50	-1.80	1.80
10	1	0.00	-1.30	2.70	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.40	1.00	-0.30	0.30
2	1	2.29	0.20	1.20	-0.50	0.50
3	1	1.14	0.10	1.30	-0.60	0.60
4	1	0.23	-0.10	1.50	-0.80	0.80
5	1	0.04	-0.30	1.70	-1.00	1.00
6	1	0.01	-0.50	1.90	-1.20	1.20
7	1	0.00	-0.70	2.10	-1.40	1.40
8	1	0.00	-0.90	2.30	-1.60	1.60
9	1	0.00	-1.10	2.50	-1.80	1.80
10	1	0.00	-1.30	2.70	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.40	1.00	-0.30	0.30
2	1	4.57	0.20	1.20	-0.50	0.50
3	1	2.29	0.10	1.30	-0.60	0.60
4	1	0.46	-0.10	1.50	-0.80	0.80
5	1	0.08	-0.30	1.70	-1.00	1.00
6	1	0.02	-0.50	1.90	-1.20	1.20
7	1	0.01	-0.70	2.10	-1.40	1.40
8	1	0.00	-0.90	2.30	-1.60	1.60
9	1	0.00	-1.10	2.50	-1.80	1.80
10	1	0.00	-1.30	2.70	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT L	NUMBER OF	S0	S1
S T	M A	NUMBER OF	S0	S1

E P	T: L:	FATIGUE CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.81	1.12	0.81	1.12
3	1	0.22	0.61	1.23	0.61	1.23
4	1	0.06	0.42	1.33	0.42	1.33
5	1	0.00	0.22	2.44	0.22	2.44
6	1	0.00	0.03	2.55	0.03	2.55

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	4.10	7.62	0.00	0.00
2	1	0.09	3.52	8.20	0.00	0.00
3	1	0.01	3.16	8.56	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	3.42	8.56	0.00	0.00
2	1	1.14	1.71	10.27	0.00	0.00
3	1	0.57	0.86	11.13	0.00	0.00
4	1	0.11	-0.86	12.84	0.00	0.00
5	1	0.02	-2.57	14.55	0.00	0.00
6	1	0.01	-4.28	16.26	0.00	0.00
7	1	0.00	-5.99	17.98	0.00	0.00
8	1	0.00	-7.70	19.69	0.00	0.00
9	1	0.00	-9.42	21.40	0.00	0.00
10	1	0.00	-11.13	23.11	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	3.42	8.56	0.00	0.00
2	1	2.29	1.71	10.27	0.00	0.00

3:	1:	1.14 :	0.86:	11.13:	0.00:	0.00:
4:	1:	0.23 :	-0.86:	12.84:	0.00:	0.00:
5:	1:	0.04 :	-2.57:	14.55:	0.00:	0.00:
6:	1:	0.01 :	-4.28:	16.26:	0.00:	0.00:
7:	1:	0.00 :	-5.99:	17.98:	0.00:	0.00:
8:	1:	0.00 :	-7.70:	19.69:	0.00:	0.00:
9:	1:	0.00 :	-9.42:	21.40:	0.00:	0.00:
10:	1:	0.00 :	-11.13:	23.11:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	38.29 :	3.42:	8.56:	0.00:	0.00:
2:	1:	4.57 :	1.71:	10.27:	0.00:	0.00:
3:	1:	2.29 :	0.86:	11.13:	0.00:	0.00:
4:	1:	0.46 :	-0.86:	12.84:	0.00:	0.00:
5:	1:	0.08 :	-2.57:	14.55:	0.00:	0.00:
6:	1:	0.02 :	-4.28:	16.26:	0.00:	0.00:
7:	1:	0.01 :	-5.99:	17.98:	0.00:	0.00:
8:	1:	0.00 :	-7.70:	19.69:	0.00:	0.00:
9:	1:	0.00 :	-9.42:	21.40:	0.00:	0.00:
10:	1:	0.00 :	-11.13:	23.11:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28 :	4.17:	4.21:	0.00:	0.00:
2:	1:	0.44 :	3.38:	4.67:	0.00:	0.00:
3:	1:	0.22 :	2.54:	5.13:	0.00:	0.00:
4:	1:	0.06 :	1.75:	5.55:	0.00:	0.00:
5:	1:	0.00 :	0.92:	10.17:	0.00:	0.00:
6:	1:	0.00 :	0.13:	10.63:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
100	15		0.440140	12.514320

200	15	0.470786	12.944208
300	15	0.505643	13.416808
400	15	0.545620	13.939613
500	15	0.591907	14.522131
600	15	0.646093	15.176664
700	15	0.710356	15.919496
800	15	0.787762	16.772784
900	15	0.882785	17.767717
1000	15	1.002247	18.950157
1100	15	1.157165	20.391517
1200	15	1.366767	22.212240
1300	15	1.668705	24.641266
1400	15	2.152549	28.213974

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =    65.92     K ref =    0.000     K cr =    65.91
at the very beginning of Load Step No.   10
Step description:
of Block No.      14  of Schedule No.    1440
Crack Size      c =   2.45642

                 FATIGUE CRACK GROWTH ANALYSIS
                 -------Modified by FAI-------
               DATE: 30-APR-99   TIME: 12:45:16
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 1, PSE-W10 .050 skin, 4 linked holes   (T

GEOMETRY
--------
MODEL: TC01-Through crack in center of plate.

Plate Thickness, t =    0.0500
  "   Width, W     =   24.0000

FLAW SIZE:

c   (init.) =   1.038



MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  66.0:  53.0:  46.0:  33.0: 1.00: 1.00:  0.050:  65.9:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.829D-08:3.284:0.50:1.00:  2.90:  0.70: 1.50: 0.30:

MODEL: TC01

FATIGUE SCHEDULE BLOCK INPUT TABLE
```

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0: 5.8600
Scale Factor for Stress S1: 0.0000

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 8.5600
Scale Factor for Stress S1: 0.0000

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 8.5600
Scale Factor for Stress S1: 0.0000

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 8.5600
Scale Factor for Stress S1: 0.0000

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 4.1700
Scale Factor for Stress S1: 0.0000

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	.8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

S T E P	M A T L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

S T E	M A T	NUMBER OF FATIGUE	S0	S1

```
 P  : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        9.57 :    0.40:     1.00:    -0.30:     0.30:
   2: 1:        1.14 :    0.20:     1.20:    -0.50:     0.50:
   3: 1:        0.57 :    0.10:     1.30:    -0.60:     0.60:
   4: 1:        0.11 :   -0.10:     1.50:    -0.80:     0.80:
   5: 1:        0.02 :   -0.30:     1.70:    -1.00:     1.00:
   6: 1:        0.01 :   -0.50:     1.90:    -1.20:     1.20:
   7: 1:        0.00 :   -0.70:     2.10:    -1.40:     1.40:
   8: 1:        0.00 :   -0.90:     2.30:    -1.60:     1.60:
   9: 1:        0.00 :   -1.10:     2.50:    -1.80:     1.80:
  10: 1:        0.00 :   -1.30:     2.70:    -2.00:     2.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S  : M:  NUMBER      :        S0          :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:       19.14 :    0.40:     1.00:    -0.30:     0.30:
   2: 1:        2.29 :    0.20:     1.20:    -0.50:     0.50:
   3: 1:        1.14 :    0.10:     1.30:    -0.60:     0.60:
   4: 1:        0.23 :   -0.10:     1.50:    -0.80:     0.80:
   5: 1:        0.04 :   -0.30:     1.70:    -1.00:     1.00:
   6: 1:        0.01 :   -0.50:     1.90:    -1.20:     1.20:
   7: 1:        0.00 :   -0.70:     2.10:    -1.40:     1.40:
   8: 1:        0.00 :   -0.90:     2.30:    -1.60:     1.60:
   9: 1:        0.00 :   -1.10:     2.50:    -1.80:     1.80:
  10: 1:        0.00 :   -1.30:     2.70:    -2.00:     2.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
 S  : M:  NUMBER      :        S0          :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:       38.29 :    0.40:     1.00:    -0.30:     0.30:
   2: 1:        4.57 :    0.20:     1.20:    -0.50:     0.50:
   3: 1:        2.29 :    0.10:     1.30:    -0.60:     0.60:
   4: 1:        0.46 :   -0.10:     1.50:    -0.80:     0.80:
   5: 1:        0.08 :   -0.30:     1.70:    -1.00:     1.00:
   6: 1:        0.02 :   -0.50:     1.90:    -1.20:     1.20:
   7: 1:        0.01 :   -0.70:     2.10:    -1.40:     1.40:
   8: 1:        0.00 :   -0.90:     2.30:    -1.60:     1.60:
   9: 1:        0.00 :   -1.10:     2.50:    -1.80:     1.80:
  10: 1:        0.00 :   -1.30:     2.70:    -2.00:     2.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  5
 S  : M:  NUMBER      :        S0          :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.28 :    1.00:     1.01:     1.00:     1.01:
   2: 1:        0.44 :    0.81:     1.12:     0.81:     1.12:
   3: 1:        0.22 :    0.61:     1.23:     0.61:     1.23:
   4: 1:        0.06 :    0.42:     1.33:     0.42:     1.33:
```

C-9 PSE W10 SA226 and SA227 Skin Slice at WS 27 Inboard (Continued)

5:	1:	0.00 :	0.22:	2.44:	0.22:	2.44:
6:	1:	0.00 :	0.03:	2.55:	0.03:	2.55:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	1.90 :	4.10:	7.62:	0.00:	0.00:
2:	1:	0.09 :	3.52:	8.20:	0.00:	0.00:
3:	1:	0.01 :	3.16:	8.56:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	9.57 :	3.42:	8.56:	0.00:	0.00:
2:	1:	1.14 :	1.71:	10.27:	0.00:	0.00:
3:	1:	0.57 :	0.86:	11.13:	0.00:	0.00:
4:	1:	0.11 :	-0.86:	12.84:	0.00:	0.00:
5:	1:	0.02 :	-2.57:	14.55:	0.00:	0.00:
6:	1:	0.01 :	-4.28:	16.26:	0.00:	0.00:
7:	1:	0.00 :	-5.99:	17.98:	0.00:	0.00:
8:	1:	0.00 :	-7.70:	19.69:	0.00:	0.00:
9:	1:	0.00 :	-9.42:	21.40:	0.00:	0.00:
10:	1:	0.00 :	-11.13:	23.11:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	19.14 :	3.42:	8.56:	0.00:	0.00:
2:	1:	2.29 :	1.71:	10.27:	0.00:	0.00:
3:	1:	1.14 :	0.86:	11.13:	0.00:	0.00:
4:	1:	0.23 :	-0.86:	12.84:	0.00:	0.00:
5:	1:	0.04 :	-2.57:	14.55:	0.00:	0.00:
6:	1:	0.01 :	-4.28:	16.26:	0.00:	0.00:
7:	1:	0.00 :	-5.99:	17.98:	0.00:	0.00:
8:	1:	0.00 :	-7.70:	19.69:	0.00:	0.00:
9:	1:	0.00 :	-9.42:	21.40:	0.00:	0.00:

```
 10: 1:        0.00 :  -11.13:   23.11:    0.00:    0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S  : M:  NUMBER     :        S0         :       S1          :
T  : A:    OF       :                   :                   :
E  : T:  FATIGUE    :      (ksi)        :      (ksi)        :
P  : L:  CYCLES     :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
  1: 1:       38.29 :    3.42:    8.56:    0.00:    0.00:
  2: 1:        4.57 :    1.71:   10.27:    0.00:    0.00:
  3: 1:        2.29 :    0.86:   11.13:    0.00:    0.00:
  4: 1:        0.46 :   -0.86:   12.84:    0.00:    0.00:
  5: 1:        0.08 :   -2.57:   14.55:    0.00:    0.00:
  6: 1:        0.02 :   -4.28:   16.26:    0.00:    0.00:
  7: 1:        0.01 :   -5.99:   17.98:    0.00:    0.00:
  8: 1:        0.00 :   -7.70:   19.69:    0.00:    0.00:
  9: 1:        0.00 :   -9.42:   21.40:    0.00:    0.00:
 10: 1:        0.00 :  -11.13:   23.11:    0.00:    0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S  : M:  NUMBER     :        S0         :       S1          :
T  : A:    OF       :                   :                   :
E  : T:  FATIGUE    :      (ksi)        :      (ksi)        :
P  : L:  CYCLES     :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        0.28 :    4.17:    4.21:    0.00:    0.00:
  2: 1:        0.44 :    3.38:    4.67:    0.00:    0.00:
  3: 1:        0.22 :    2.54:    5.13:    0.00:    0.00:
  4: 1:        0.06 :    1.75:    5.55:    0.00:    0.00:
  5: 1:        0.00 :    0.92:   10.17:    0.00:    0.00:
  6: 1:        0.00 :    0.13:   10.63:    0.00:    0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 THROUGH CRACK CASE 1, PSE-W
MODEL: TC01

ANALYSIS RESULTS:
-----------------


 Schedl    Block          Final Flaw Size            K max
                 Step           c                    c-tip
   100       15              1.204624              20.815551
   200       15              1.433152              22.763607
   300       15              1.769501              25.412920
   400       15              2.332196              29.472280

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =    65.92     K ref =    0.000     K cr =    65.91
```

C-9 PSE W10 SA226 and SA227 Skin Slice at WS 27 Inboard (Continued)

```
at Cycle No.         0.00  of Load Step No.   10
Step description:
of Block No.       5  of Schedule No.     415
Crack Size      c =  2.45690
```

C-10 PSE W11 SA226 Wing Lower Center Section Skin at Landing Light Cutout

```
                    FATIGUE CRACK GROWTH ANALYSIS
                   -----------------------------
                  DATE: 09/18/98    TIME: 11:01:02
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - Roark

GEOMETRY
--------
MODEL: TC01-Through crack in center of plate.

Plate Thickness, t =    0.0500
  "   Width, W     =    5.0000

FLAW SIZE:

c   (init.) =  0.2500E-01



MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  66.0:  53.0:  46.0:  33.0: 1.00: 1.00:  0.050:  65.9:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:----------:-----:----:----:------:------:-----:-----:
:  1 :0.829E-08:3.284:0.50:1.00:  2.90:  0.70: 1.50: 0.30:
 THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - Roark
MODEL: TC01

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -2.0000
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    13.540
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    13.540
Scale Factor for Stress S1:   0.00000
```

C-10 PSE W11 SA226 Wing Lower Center Section Skin at Landing Light Cutout (Continued)

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 13.540
Scale Factor for Stress S1: 0.00000

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 4.2000
Scale Factor for Stress S1: 0.00000

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	9.57	0.38	0.98	0.38	0.98
2	1	1.14	0.18	1.18	0.18	1.18
3	1	0.57	0.08	1.28	0.08	1.28
4	1	0.11	-0.12	1.48	-0.12	1.48
5	1	0.02	-0.32	1.68	-0.32	1.68
6	1	0.01	-0.52	1.88	-0.52	1.88
7	1	0.00	-0.72	2.08	-0.72	2.08
8	1	0.00	-0.92	2.28	-0.92	2.28
9	1	0.00	-1.12	2.48	-1.12	2.48
10	1	0.00	-1.32	2.68	-1.32	2.68

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT'L	NUMBER	S0	S1

T : A:	OF				
E : T:	FATIGUE				
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	19.14	0.38	0.98	0.38	0.98
2: 1:	2.29	0.18	1.18	0.18	1.18
3: 1:	1.14	0.08	1.28	0.08	1.28
4: 1:	0.23	-0.12	1.48	-0.12	1.48
5: 1:	0.04	-0.32	1.68	-0.32	1.68
6: 1:	0.01	-0.52	1.88	-0.52	1.88
7: 1:	0.00	-0.72	2.08	-0.72	2.08
8: 1:	0.00	-0.92	2.28	-0.92	2.28
9: 1:	0.00	-1.12	2.48	-1.12	2.48
10: 1:	0.00	-1.32	2.68	-1.32	2.68

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

S : M:	NUMBER	S0		S1	
T : A:	OF				
E : T:	FATIGUE				
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	38.29	0.38	0.98	0.38	0.98
2: 1:	4.57	0.18	1.18	0.18	1.18
3: 1:	2.29	0.08	1.28	0.08	1.28
4: 1:	0.46	-0.12	1.48	-0.12	1.48
5: 1:	0.08	-0.32	1.68	-0.32	1.68
6: 1:	0.02	-0.52	1.88	-0.52	1.88
7: 1:	0.01	-0.72	2.08	-0.72	2.08
8: 1:	0.00	-0.92	2.28	-0.92	2.28
9: 1:	0.00	-1.12	2.48	-1.12	2.48
10: 1:	0.00	-1.32	2.68	-1.32	2.68

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

S : M:	NUMBER	S0		S1	
T : A:	OF				
E : T:	FATIGUE				
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	0.28	1.00	1.01	1.00	1.01
2: 1:	0.44	0.75	1.23	0.75	1.23
3: 1:	0.22	0.50	1.46	0.50	1.46
4: 1:	0.06	0.26	1.69	0.26	1.69
5: 1:	0.00	0.01	1.92	0.01	1.92
6: 1:	0.00	-0.24	2.14	-0.24	2.14

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - Roark
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S : M:	NUMBER	S0		S1	
T : A:	OF				
E : T:	FATIGUE	(ksi)		(ksi)	
P : L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1: 1:	1.90	-1.40	-2.60	0.00	0.00
2: 1:	0.09	-1.20	-2.80	0.00	0.00

3:	1:	0.01	-1.08	-2.92	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - Roark
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	9.57	5.15	13.27	0.00	0.00
2:	1:	1.14	2.44	15.98	0.00	0.00
3:	1:	0.57	1.08	17.33	0.00	0.00
4:	1:	0.11	-1.62	20.04	0.00	0.00
5:	1:	0.02	-4.33	22.75	0.00	0.00
6:	1:	0.01	-7.04	25.46	0.00	0.00
7:	1:	0.00	-9.75	28.16	0.00	0.00
8:	1:	0.00	-12.46	30.87	0.00	0.00
9:	1:	0.00	-15.16	33.58	0.00	0.00
10:	1:	0.00	-17.87	36.29	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - Roark
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	19.14	5.15	13.27	0.00	0.00
2:	1:	2.29	2.44	15.98	0.00	0.00
3:	1:	1.14	1.08	17.33	0.00	0.00
4:	1:	0.23	-1.62	20.04	0.00	0.00
5:	1:	0.04	-4.33	22.75	0.00	0.00
6:	1:	0.01	-7.04	25.46	0.00	0.00
7:	1:	0.00	-9.75	28.16	0.00	0.00
8:	1:	0.00	-12.46	30.87	0.00	0.00
9:	1:	0.00	-15.16	33.58	0.00	0.00
10:	1:	0.00	-17.87	36.29	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - Roark
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	38.29	5.15	13.27	0.00	0.00
2:	1:	4.57	2.44	15.98	0.00	0.00
3:	1:	2.29	1.08	17.33	0.00	0.00

```
    4: 1:          0.46 :     -1.62:     20.04:      0.00:      0.00:
    5: 1:          0.08 :     -4.33:     22.75:      0.00:      0.00:
    6: 1:          0.02 :     -7.04:     25.46:      0.00:      0.00:
    7: 1:          0.01 :     -9.75:     28.16:      0.00:      0.00:
    8: 1:          0.00 :    -12.46:     30.87:      0.00:      0.00:
    9: 1:          0.00 :    -15.16:     33.58:      0.00:      0.00:
   10: 1:          0.00 :    -17.87:     36.29:      0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - Roark
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER       :        S0         :        S1         :
T   : A:    OF         :                   :                   :
E   : T:  FATIGUE      :      (ksi)        :      (ksi)        :
P   : L:  CYCLES       :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
   1: 1:          0.28 :      4.20:      4.24:      0.00:      0.00:
   2: 1:          0.44 :      3.15:      5.17:      0.00:      0.00:
   3: 1:          0.22 :      2.10:      6.13:      0.00:      0.00:
   4: 1:          0.06 :      1.09:      7.10:      0.00:      0.00:
   5: 1:          0.00 :      0.04:      8.06:      0.00:      0.00:
   6: 1:          0.00 :     -1.01:      8.99:      0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - Roark
MODEL: TC01

ANALYSIS RESULTS:
-----------------


 Schedl     Block             Final Flaw Size            K max
                   Step              c                   c-tip
    200       15                 0.026285              2.582992
    400       15                 0.027728              2.652981
    600       15                 0.029358              2.729857
    800       15                 0.031210              2.814651
   1000       15                 0.033328              2.908626
   1200       15                 0.035769              3.013345
   1400       15                 0.038610              3.130771
   1600       15                 0.041948              3.263402
   1800       15                 0.045919              3.414472
   2000       15                 0.050707              3.588259
   2200       15                 0.056579              3.790547
   2400       15                 0.063923              4.029408
   2600       15                 0.073336              4.316445
   2800       15                 0.085775              4.669107
   3000       15                 0.102882              5.115192
   3200       15                 0.127708              5.702268
   3400       15                 0.166638              6.521042
   3600       15                 0.235693              7.776803
   3800       15                 0.391306             10.118750

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.    10
Step description:
of Block No.      8   of Schedule No.     3950
Crack Size      c =   0.788815
```

```
FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =    65.99     K ref =   0.0000     K cr =    65.91
at the very beginning of Load Step No.   10
Step description:
of Block No.       8  of Schedule No.    3964
Crack Size     c =  0.891819


                  FATIGUE CRACK GROWTH ANALYSIS
                 -----------------------------
                 DATE: 09/18/98    TIME: 11:02:22
         (computed: NASA/FLAGRO Version 2.03, March 1995.)
         U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - NASBEM

GEOMETRY
--------
MODEL: TC01-Through crack in center of plate.

Plate Thickness, t =    0.0500
  "   Width, W     =    5.0000

FLAW SIZE:

c   (init.) =  0.2500E-01




MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS   :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc   : KIscc:
: No.:      :       :      :      :     :     :       :       :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  66.0:  53.0:  46.0:  33.0: 1.00: 1.00:  0.050:  65.9:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.829E-08:3.284:0.50:1.00:  2.90:  0.70: 1.50: 0.30:
 THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - NASBEM
MODEL: TC01

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   -1.5000
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  2
```

```
Scale Factor for Stress S0:    10.150
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    10.150
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    10.150
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    3.1500
Scale Factor for Stress S1:   0.00000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
    1   -     1                       1
    2   -     2                       2
    3   -     3                       5
    4   -     4                       1
    5   -     5                       3
    6   -     6                       5
    7   -     7                       1
    8   -     8                       3
    9   -     9                       5
   10   -    10                       1
   11   -    11                       3
   12   -    12                       5
   13   -    13                       1
   14   -    14                       4
   15   -    15                       5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :         S0          :         S1          :
 T  : A:    OF        :                     :                     :
 E  : T:  FATIGUE     :                     :                     :
 P  : L:  CYCLES      :    (t1) :   (t2)    :    (t1) :   (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.90 :     0.70:     1.30:     0.70:     1.30:
   2: 1:        0.09 :     0.60:     1.40:     0.60:     1.40:
   3: 1:        0.01 :     0.54:     1.46:     0.54:     1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER      :         S0          :         S1          :
 T  : A:    OF        :                     :                     :
 E  : T:  FATIGUE     :                     :                     :
 P  : L:  CYCLES      :    (t1) :   (t2)    :    (t1) :   (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        9.57 :     0.38:     0.98:     0.38:     0.98:
   2: 1:        1.14 :     0.18:     1.18:     0.18:     1.18:
   3: 1:        0.57 :     0.08:     1.28:     0.08:     1.28:
   4: 1:        0.11 :    -0.12:     1.48:    -0.12:     1.48:
   5: 1:        0.02 :    -0.32:     1.68:    -0.32:     1.68:
   6: 1:        0.01 :    -0.52:     1.88:    -0.52:     1.88:
   7: 1:        0.00 :    -0.72:     2.08:    -0.72:     2.08:
   8: 1:        0.00 :    -0.92:     2.28:    -0.92:     2.28:
   9: 1:        0.00 :    -1.12:     2.48:    -1.12:     2.48:
  10: 1:        0.00 :    -1.32:     2.68:    -1.32:     2.68:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.38	0.98	0.38	0.98
2	1	2.29	0.18	1.18	0.18	1.18
3	1	1.14	0.08	1.28	0.08	1.28
4	1	0.23	-0.12	1.48	-0.12	1.48
5	1	0.04	-0.32	1.68	-0.32	1.68
6	1	0.01	-0.52	1.88	-0.52	1.88
7	1	0.00	-0.72	2.08	-0.72	2.08
8	1	0.00	-0.92	2.28	-0.92	2.28
9	1	0.00	-1.12	2.48	-1.12	2.48
10	1	0.00	-1.32	2.68	-1.32	2.68

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	0.38	0.98	0.38	0.98
2	1	4.57	0.18	1.18	0.18	1.18
3	1	2.29	0.08	1.28	0.08	1.28
4	1	0.46	-0.12	1.48	-0.12	1.48
5	1	0.08	-0.32	1.68	-0.32	1.68
6	1	0.02	-0.52	1.88	-0.52	1.88
7	1	0.01	-0.72	2.08	-0.72	2.08
8	1	0.00	-0.92	2.28	-0.92	2.28
9	1	0.00	-1.12	2.48	-1.12	2.48
10	1	0.00	-1.32	2.68	-1.32	2.68

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.75	1.23	0.75	1.23
3	1	0.22	0.50	1.46	0.50	1.46
4	1	0.06	0.26	1.69	0.26	1.69
5	1	0.00	0.01	1.92	0.01	1.92
6	1	0.00	-0.24	2.14	-0.24	2.14

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - NASBEM
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	-1.05	-1.95	0.00	0.00
2	1	0.09	-0.90	-2.10	0.00	0.00
3	1	0.01	-0.81	-2.19	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - NASBEM
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	3.86	9.95	0.00	0.00
2	1	1.14	1.83	11.98	0.00	0.00
3	1	0.57	0.81	12.99	0.00	0.00
4	1	0.11	-1.22	15.02	0.00	0.00
5	1	0.02	-3.25	17.05	0.00	0.00
6	1	0.01	-5.28	19.08	0.00	0.00
7	1	0.00	-7.31	21.11	0.00	0.00
8	1	0.00	-9.34	23.14	0.00	0.00
9	1	0.00	-11.37	25.17	0.00	0.00
10	1	0.00	-13.40	27.20	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - NASBEM
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	3.86	9.95	0.00	0.00
2	1	2.29	1.83	11.98	0.00	0.00
3	1	1.14	0.81	12.99	0.00	0.00
4	1	0.23	-1.22	15.02	0.00	0.00
5	1	0.04	-3.25	17.05	0.00	0.00
6	1	0.01	-5.28	19.08	0.00	0.00
7	1	0.00	-7.31	21.11	0.00	0.00
8	1	0.00	-9.34	23.14	0.00	0.00
9	1	0.00	-11.37	25.17	0.00	0.00
10	1	0.00	-13.40	27.20	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - NASBEM
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S	M:	NUMBER	S0	S1

T / E / P	A: / T: / L:	OF FATIGUE CYCLES	(ksi) (t1)	(ksi) (t2)	(ksi) (t1)	(ksi) (t2)
1:	1:	38.29	3.86:	9.95:	0.00:	0.00:
2:	1:	4.57	1.83:	11.98:	0.00:	0.00:
3:	1:	2.29	0.81:	12.99:	0.00:	0.00:
4:	1:	0.46	-1.22:	15.02:	0.00:	0.00:
5:	1:	0.08	-3.25:	17.05:	0.00:	0.00:
6:	1:	0.02	-5.28:	19.08:	0.00:	0.00:
7:	1:	0.01	-7.31:	21.11:	0.00:	0.00:
8:	1:	0.00	-9.34:	23.14:	0.00:	0.00:
9:	1:	0.00	-11.37:	25.17:	0.00:	0.00:
10:	1:	0.00	-13.40:	27.20:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - NASBEM
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28	3.15:	3.18:	0.00:	0.00:
2:	1:	0.44	2.36:	3.87:	0.00:	0.00:
3:	1:	0.22	1.57:	4.60:	0.00:	0.00:
4:	1:	0.06	0.82:	5.32:	0.00:	0.00:
5:	1:	0.00	0.03:	6.05:	0.00:	0.00:
6:	1:	0.00	-0.76:	6.74:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - NASBEM
MODEL: TC01

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.025195	1.896632
400	15		0.025394	1.904097
600	15		0.025596	1.911677
800	15		0.025803	1.919374
1000	15		0.026013	1.927190
1200	15		0.026228	1.935129
1400	15		0.026447	1.943191
1600	15		0.026670	1.951381
1800	15		0.026898	1.959702
2000	15		0.027130	1.968155
2200	15		0.027368	1.976743
2400	15		0.027610	1.985471
2600	15		0.027857	1.994341
2800	15		0.028109	2.003356
3000	15		0.028367	2.012520
3200	15		0.028630	2.021836
3400	15		0.028899	2.031307
3600	15		0.029173	2.040939
3800	15		0.029454	2.050733
4000	15		0.029741	2.060695

4200	15	0.030034	2.070828
4400	15	0.030334	2.081136
4600	15	0.030640	2.091625
4800	15	0.030953	2.102298
5000	15	0.031274	2.113161
5200	15	0.031630	2.125154
5400	15	0.032027	2.138463
5600	15	0.032456	2.152752
5800	15	0.032916	2.167945
6000	15	0.033405	2.184016
6200	15	0.033926	2.200963
6400	15	0.034477	2.218795
6600	15	0.035062	2.237533
6800	15	0.035681	2.257204
7000	15	0.036336	2.277839
7200	15	0.037029	2.299480
7400	15	0.037763	2.322169
7600	15	0.038540	2.345957
7800	15	0.039364	2.370899
8000	15	0.040236	2.397057
8200	15	0.041162	2.424500
8400	15	0.042146	2.453303
8600	15	0.043190	2.483549
8800	15	0.044302	2.515331
9000	15	0.045486	2.548750
9200	15	0.046749	2.583919
9400	15	0.048098	2.620961
9600	15	0.049540	2.660016
9800	15	0.051086	2.701236
10000	15	0.052745	2.744794

THROUGH CRACK CASE 1, PSE-W11 crack in belly skin - NASBEM
MODEL: TC01

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
10200	15		0.054529	2.790880
10400	15		0.056452	2.839710
10600	15		0.058528	2.891525
10800	15		0.060775	2.946599
11000	15		0.063215	3.005242
11200	15		0.065870	3.067807
11400	15		0.068768	3.134699
11600	15		0.071943	3.206382
11800	15		0.075433	3.283396
12000	15		0.079284	3.366367
12200	15		0.083552	3.456030
12400	15		0.088305	3.553253
12600	15		0.093625	3.659070
12800	15		0.099614	3.774724
13000	15		0.106401	3.901726
13200	15		0.114147	4.041937
13400	15		0.123060	4.197663
13600	15		0.133413	4.371822
13800	15		0.145568	4.568172
14000	15		0.160020	4.791652
14200	15		0.177459	5.048943
14400	15		0.198881	5.349292
14600	15		0.225783	5.706067
14800	15		0.260516	6.139583
15000	15		0.307043	6.682903
15200	15		0.372651	7.395340
15400	15		0.472749	8.401144
15600	15		0.649027	10.046387
15800	15		1.123464	14.517017

```
ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.   10
Step description:
of Block No.     14  of Schedule No.   15816
Crack Size     c =   1.21771

FINAL RESULTS:
Unstable crack growth, max stress intensity exceeds critical value:
K max =     66.06     K ref =    0.0000     K cr =     65.91
at the very beginning of Load Step No.   10
Step description:
of Block No.      2  of Schedule No.   15826
Crack Size     c =   1.29207
```

C-11 PSE W12 SA227 Tip Extension Fitting Rear Spar Lower Surface

```
                         FATIGUE CRACK GROWTH ANALYSIS
                         -------Modified by FAI-------
                       DATE: 03-NOV-97   TIME: 11:43:51
                 (computed: NASA/FLAGRO Version 2.03, March 1995.)
                 U.S. customary units [inches, ksi, ksi sqrt(in)]

         PROBLEM TITLE
         -------------
         PSE-W12, sa227<16,500 crack in angle  1st fastener

         GEOMETRY
         --------
         MODEL: TC03-Through crack from hole in plate.

         Plate Thickness, t =    0.1250
           "   Width, W     =    0.7500
         Hole Diameter, D   =    0.1900
         Hole-Center-to-Edge Dist., B =    0.3750

         FLAW SIZE:

         c   (init.) =  0.5000E-01



         MATERIAL
         --------

         MATL 1: 2014-T6
                 Plt & sht; L-T

         Material Properties:

         :Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
         : No.:      :      :      :      :     :     :       :      :      :
         :----:------:------:------:------:-----:-----:-------:------:------:
         :  1 :  74.0:  65.0:  38.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

         :Matl:---------- Crack Growth Eqn Constants -------------:
         : No.:    C    :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
         :    :         :     :    :    :      :      :     :SIGo :
         :----:---------:-----:----:----:------:------:-----:-----:
         :  1 :0.350D-07:2.800:0.50:1.00:  2.70:  0.70: 1.50: 0.30:

         MODEL: TC03

         FATIGUE SCHEDULE BLOCK INPUT TABLE
         ----------------------------------
         STD

         [Note: Stress = Input Value * Stress Factor]

         Stress Scaling Factors for Block Case:  1

         Scale Factor for Stress S0:    0.0000
         Scale Factor for Stress S3:    0.0000

         Stress Scaling Factors for Block Case:  2

         Scale Factor for Stress S0:   0.56000
         Scale Factor for Stress S3:    5.0500

         Stress Scaling Factors for Block Case:  3

         Scale Factor for Stress S0:   0.58000
         Scale Factor for Stress S3:    5.2200
```

C-11 PSE W12 SA227 Tip Extension Fitting Rear Spar Lower Surface (Continued)

```
Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:   0.65000
Scale Factor for Stress S3:    5.8500

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:   0.26000
Scale Factor for Stress S3:    2.3600

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                    Block Case No.
From    -   To
    1   -      1                          1
    2   -      2                          2
    3   -      3                          5
    4   -      4                          1
    5   -      5                          3
    6   -      6                          5
    7   -      7                          1
    8   -      8                          3
    9   -      9                          5
   10   -     10                          1
   11   -     11                          3
   12   -     12                          5
   13   -     13                          1
   14   -     14                          4
   15   -     15                          5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :        S0          :        S3          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :                    :                    :
 P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:      1.30:    0.70:      1.30:
   2: 1:         0.09 :    0.60:      1.40:    0.60:      1.40:
   3: 1:         0.01 :    0.46:      1.46:    0.54:      1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S   : M:  NUMBER      :        S0          :        S3          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :                    :                    :
 P   : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :    0.45:      1.05:    0.45:      1.05:
   2: 1:         1.14 :    0.25:      1.25:    0.25:      1.25:
   3: 1:         0.57 :    0.15:      1.35:    0.15:      1.35:
   4: 1:         0.11 :   -0.05:      1.55:   -0.05:      1.55:
   5: 1:         0.02 :   -0.25:      1.75:   -0.25:      1.75:
   6: 1:         0.01 :   -0.45:      1.95:   -0.45:      1.95:
   7: 1:         0.00 :   -0.65:      2.15:   -0.65:      2.15:
   8: 1:         0.00 :   -0.85:      2.35:   -0.85:      2.35:
   9: 1:         0.00 :   -1.05:      2.55:   -1.05:      2.55:
  10: 1:         0.00 :   -1.25:      2.75:   -1.25:      2.75:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S   : M:  NUMBER      :        S0          :        S3          :
```

C-11 PSE W12 SA227 Tip Extension Fitting Rear Spar Lower Surface (Continued)

```
 T  : A:   OF         :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        19.14 :    0.46:     1.06:     0.45:     1.05:
   2: 1:         2.29 :    0.26:     1.26:     0.25:     1.25:
   3: 1:         1.14 :    0.16:     1.36:     0.15:     1.35:
   4: 1:         0.23 :   -0.04:     1.56:    -0.05:     1.55:
   5: 1:         0.04 :   -0.24:     1.76:    -0.25:     1.75:
   6: 1:         0.01 :   -0.44:     1.96:    -0.45:     1.95:
   7: 1:         0.00 :   -0.64:     2.16:    -0.65:     2.15:
   8: 1:         0.00 :   -0.84:     2.36:    -0.85:     2.35:
   9: 1:         0.00 :   -1.04:     2.56:    -1.05:     2.55:
  10: 1:         0.00 :   -1.24:     2.76:    -1.25:     2.75:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
 S  : M:  NUMBER      :        S0          :        S3          :
 T  : A:   OF         :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:        38.29 :    0.45:     1.05:     0.45:     1.05:
   2: 1:         4.57 :    0.25:     1.25:     0.25:     1.25:
   3: 1:         2.29 :    0.15:     1.35:     0.15:     1.35:
   4: 1:         0.46 :   -0.05:     1.55:    -0.05:     1.55:
   5: 1:         0.08 :   -0.25:     1.75:    -0.25:     1.75:
   6: 1:         0.02 :   -0.45:     1.95:    -0.45:     1.95:
   7: 1:         0.01 :   -0.65:     2.15:    -0.65:     2.15:
   8: 1:         0.00 :   -0.85:     2.35:    -0.85:     2.35:
   9: 1:         0.00 :   -1.05:     2.55:    -1.05:     2.55:
  10: 1:         0.00 :   -1.25:     2.75:    -1.25:     2.75:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  5
 S  : M:  NUMBER      :        S0          :        S3          :
 T  : A:   OF         :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         0.28 :    1.00:     1.01:     1.00:     1.01:
   2: 1:         0.44 :    0.00:     1.74:     0.00:     1.74:
   3: 1:         0.22 :   -1.00:     2.48:    -1.00:     2.48:
   4: 1:         0.06 :   -2.00:     3.22:    -2.00:     3.22:
   5: 1:         0.00 :   -3.00:     3.96:    -3.00:     3.96:
   6: 1:         0.00 :   -4.00:     4.70:    -4.00:     4.70:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 PSE-W12, sa227<16,500 crack
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
 S  : M:  NUMBER      :        S0          :        S3          :
 T  : A:   OF         :                    :                    :
 E  : T:  FATIGUE     :      (ksi)         :      (ksi)         :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.00:     0.00:     0.00:     0.00:
   2: 1:         0.09 :    0.00:     0.00:     0.00:     0.00:
```

C-11 PSE W12 SA227 Tip Extension Fitting Rear Spar Lower Surface (Continued)

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W12, sa227<16,500 crack
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	0.25	0.59	2.27	5.30
2	1	1.14	0.14	0.70	1.26	6.31
3	1	0.57	0.08	0.76	0.76	6.82
4	1	0.11	-0.03	0.87	-0.25	7.83
5	1	0.02	-0.14	0.98	-1.26	8.84
6	1	0.01	-0.25	1.09	-2.27	9.85
7	1	0.00	-0.36	1.20	-3.28	10.86
8	1	0.00	-0.48	1.32	-4.29	11.87
9	1	0.00	-0.59	1.43	-5.30	12.88
10	1	0.00	-0.70	1.54	-6.31	13.89

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W12, sa227<16,500 crack
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	0.27	0.61	2.35	5.48
2	1	2.29	0.15	0.73	1.30	6.52
3	1	1.14	0.09	0.79	0.78	7.05
4	1	0.23	-0.02	0.90	-0.26	8.09
5	1	0.04	-0.14	1.02	-1.30	9.13
6	1	0.01	-0.26	1.14	-2.35	10.18
7	1	0.00	-0.37	1.25	-3.39	11.22
8	1	0.00	-0.49	1.37	-4.44	12.27
9	1	0.00	-0.60	1.48	-5.48	13.31
10	1	0.00	-0.72	1.60	-6.52	14.35

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W12, sa227<16,500 crack
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	0.29	0.68	2.63	6.14
2	1	4.57	0.16	0.81	1.46	7.31
3	1	2.29	0.10	0.88	0.88	7.90

4:	1:	0.46 :	-0.03:	1.01:	-0.29:	9.07:
5:	1:	0.08 :	-0.16:	1.14:	-1.46:	10.24:
6:	1:	0.02 :	-0.29:	1.27:	-2.63:	11.41:
7:	1:	0.01 :	-0.42:	1.40:	-3.80:	12.58:
8:	1:	0.00 :	-0.55:	1.53:	-4.97:	13.75:
9:	1:	0.00 :	-0.68:	1.66:	-6.14:	14.92:
10:	1:	0.00 :	-0.81:	1.79:	-7.31:	16.09:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W12, sa227<16,500 crack
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	0.28 :	0.26:	0.26:	2.36:	2.38:
2:	1:	0.44 :	0.00:	0.45:	0.00:	4.11:
3:	1:	0.22 :	-0.26:	0.64:	-2.36:	5.85:
4:	1:	0.06 :	-0.52:	0.84:	-4.72:	7.60:
5:	1:	0.00 :	-0.78:	1.03:	-7.08:	9.35:
6:	1:	0.00 :	-1.04:	1.22:	-9.44:	11.09:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W12, sa227<16,500 crack
MODEL: TC03

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
500	15		0.050051	3.552443
1000	15		0.050102	3.552321
1500	15		0.050153	3.552200
2000	15		0.050204	3.552078
2500	15		0.050255	3.551957
3000	15		0.050306	3.551835
3500	15		0.050357	3.551714
4000	15		0.050408	3.551592
4500	15		0.050458	3.551470
5000	15		0.050509	3.551349
5500	15		0.050560	3.551227
6000	15		0.050611	3.551106
6500	15		0.050661	3.550984
7000	15		0.050712	3.550862
7500	15		0.050763	3.550741
8000	15		0.050813	3.550619
8500	15		0.050864	3.550498
9000	15		0.050914	3.550376
9500	15		0.050965	3.550255
10000	15		0.051015	3.550133
10500	15		0.051066	3.550012
11000	15		0.051116	3.549890
11500	15		0.051167	3.549769
12000	15		0.051217	3.549647
12500	15		0.051268	3.549526
13000	15		0.051318	3.549404
13500	15		0.051368	3.549283

14000	15	0.051419	3.549161
14500	15	0.051469	3.549040
15000	15	0.051519	3.548919
15500	15	0.051569	3.548798
16000	15	0.051619	3.548676
16500	15	0.051670	3.548555
17000	15	0.051720	3.548434
17500	15	0.051770	3.548313
18000	15	0.051820	3.548192
18500	15	0.051870	3.548070
19000	15	0.051920	3.547949
19500	15	0.051970	3.547828
20000	15	0.052020	3.547707
20500	15	0.052070	3.547587
21000	15	0.052120	3.547466
21500	15	0.052170	3.547345
22000	15	0.052219	3.547224
22500	15	0.052269	3.547103
23000	15	0.052319	3.546983
23500	15	0.052369	3.546862
24000	15	0.052418	3.546742
24500	15	0.052468	3.546621
25000	15	0.052518	3.546501

MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
25500	15		0.052568	3.546380
26000	15		0.052617	3.546260
26500	15		0.052667	3.546140
27000	15		0.052716	3.546020
27500	15		0.052766	3.545899
28000	15		0.052815	3.545779
28500	15		0.052865	3.545659
29000	15		0.052914	3.545539
29500	15		0.052964	3.545420
30000	15		0.053013	3.545300

```
FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No.         0.00  of Load Step No.    6
Step description:
of Block No.      15  of Schedule No.   30000
Crack Size      c =  0.530130E-01
```

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    -------Modified by FAI-------
                  DATE: 03-NOV-97   TIME: 11:45:23
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]
```

PROBLEM TITLE

PSE-W12, sa227=16,500 crack in angle 1st fastener

GEOMETRY

MODEL: TC03-Through crack from hole in plate.

```
Plate Thickness, t =    0.1250
  "   Width, W     =    0.7500
Hole Diameter, D   =    0.1900
Hole-Center-to-Edge Dist., B =    0.3750
```

C-11 PSE W12 SA227 Tip Extension Fitting Rear Spar Lower Surface (Continued)

```
FLAW SIZE:

c   (init.) =  0.5000E-01



MATERIAL
--------

MATL 1: 2014-T6
        Plt & sht; L-T

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c : Ak  :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  38.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C    :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :         :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.350D-07:2.800:0.50:1.00:  2.70:  0.70: 1.50: 0.30:

MODEL: TC03

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:   0.65000
Scale Factor for Stress S3:    4.1300

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:   0.68000
Scale Factor for Stress S3:    4.2900

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:   0.76000
Scale Factor for Stress S3:    4.8000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:   0.30000
Scale Factor for Stress S3:    1.9400

Total No. of Blocks in Schedule =     15

   Block Number and Case Correspondences
 Block Number                 Block Case No.
From    -   To
    1   -      1                        1
    2   -      2                        2
    3   -      3                        5
    4   -      4                        1
```

C-11 PSE W12 SA227 Tip Extension Fitting Rear Spar Lower Surface (Continued)

5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.46	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	9.57	0.45	1.05	0.46	1.06
2	1	1.14	0.25	1.25	0.26	1.26
3	1	0.57	0.15	1.35	0.16	1.36
4	1	0.11	-0.05	1.55	-0.04	1.56
5	1	0.02	-0.25	1.75	-0.24	1.76
6	1	0.01	-0.45	1.95	-0.44	1.96
7	1	0.00	-0.65	2.15	-0.64	2.16
8	1	0.00	-0.85	2.35	-0.84	2.36
9	1	0.00	-1.05	2.55	-1.04	2.56
10	1	0.00	-1.25	2.75	-1.24	2.76

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	0.45	1.05	0.46	1.06
2	1	2.29	0.25	1.25	0.26	1.26
3	1	1.14	0.15	1.35	0.16	1.36
4	1	0.23	-0.05	1.55	-0.04	1.56
5	1	0.04	-0.25	1.75	-0.24	1.76
6	1	0.01	-0.45	1.95	-0.44	1.96
7	1	0.00	-0.65	2.15	-0.64	2.16
8	1	0.00	-0.85	2.35	-0.84	2.36
9	1	0.00	-1.05	2.55	-1.04	2.56
10	1	0.00	-1.25	2.75	-1.24	2.76

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

C-11 PSE W12 SA227 Tip Extension Fitting Rear Spar Lower Surface (Continued)

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	0.45	1.05	0.45	1.05
2	1	4.57	0.25	1.25	0.25	1.25
3	1	2.29	0.15	1.35	0.15	1.35
4	1	0.46	-0.05	1.55	-0.05	1.55
5	1	0.08	-0.25	1.75	-0.25	1.75
6	1	0.02	-0.45	1.95	-0.45	1.95
7	1	0.01	-0.65	2.15	-0.65	2.15
8	1	0.00	-0.85	2.35	-0.85	2.35
9	1	0.00	-1.05	2.55	-1.05	2.55
10	1	0.00	-1.25	2.75	-1.25	2.75

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.00	1.74	0.00	1.74
3	1	0.22	-1.00	2.48	-1.00	2.48
4	1	0.06	-2.00	3.22	-2.00	3.22
5	1	0.00	-3.00	3.96	-3.00	3.96
6	1	0.00	-4.00	4.70	-4.00	4.70

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W12, sa227=16,500 crack
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W12, sa227=16,500 crack
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	0.29	0.68	1.90	4.38
2	1	1.14	0.16	0.81	1.07	5.20
3	1	0.57	0.10	0.88	0.66	5.62
4	1	0.11	-0.03	1.01	-0.17	6.44

5:	1:	0.02 :	-0.16:	1.14:	-0.99:	7.27:
6:	1:	0.01 :	-0.29:	1.27:	-1.82:	8.09:
7:	1:	0.00 :	-0.42:	1.40:	-2.64:	8.92:
8:	1:	0.00 :	-0.55:	1.53:	-3.47:	9.75:
9:	1:	0.00 :	-0.68:	1.66:	-4.30:	10.57:
10:	1:	0.00 :	-0.81:	1.79:	-5.12:	11.40:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W12, sa227=16,500 crack
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	19.14 :	0.31:	0.71:	1.97:	4.55:
2:	1:	2.29 :	0.17:	0.85:	1.12:	5.41:
3:	1:	1.14 :	0.10:	0.92:	0.69:	5.83:
4:	1:	0.23 :	-0.03:	1.05:	-0.17:	6.69:
5:	1:	0.04 :	-0.17:	1.19:	-1.03:	7.55:
6:	1:	0.01 :	-0.31:	1.33:	-1.89:	8.41:
7:	1:	0.00 :	-0.44:	1.46:	-2.75:	9.27:
8:	1:	0.00 :	-0.58:	1.60:	-3.60:	10.12:
9:	1:	0.00 :	-0.71:	1.73:	-4.46:	10.98:
10:	1:	0.00 :	-0.85:	1.87:	-5.32:	11.84:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W12, sa227=16,500 crack
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	38.29 :	0.34:	0.80:	2.16:	5.04:
2:	1:	4.57 :	0.19:	0.95:	1.20:	6.00:
3:	1:	2.29 :	0.11:	1.03:	0.72:	6.48:
4:	1:	0.46 :	-0.04:	1.18:	-0.24:	7.44:
5:	1:	0.08 :	-0.19:	1.33:	-1.20:	8.40:
6:	1:	0.02 :	-0.34:	1.48:	-2.16:	9.36:
7:	1:	0.01 :	-0.49:	1.63:	-3.12:	10.32:
8:	1:	0.00 :	-0.65:	1.79:	-4.08:	11.28:
9:	1:	0.00 :	-0.80:	1.94:	-5.04:	12.24:
10:	1:	0.00 :	-0.95:	2.09:	-6.00:	13.20:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W12, sa227=16,500 crack
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STE	MAT	NUMBER OF FATIGUE	S0 (ksi)	S3 (ksi)

```
 P  : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.28 :    0.30:      0.30:     1.94:      1.96:
   2: 1:        0.44 :    0.00:      0.52:     0.00:      3.38:
   3: 1:        0.22 :   -0.30:      0.74:    -1.94:      4.81:
   4: 1:        0.06 :   -0.60:      0.97:    -3.88:      6.25:
   5: 1:        0.00 :   -0.90:      1.19:    -5.82:      7.68:
   6: 1:        0.00 :   -1.20:      1.41:    -7.76:      9.12:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W12, sa227=16,500 crack
MODEL: TC03

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
500	15		0.050024	3.214849
1000	15		0.050048	3.214821
1500	15		0.050073	3.214793
2000	15		0.050097	3.214766
2500	15		0.050121	3.214738
3000	15		0.050145	3.214710
3500	15		0.050169	3.214682
4000	15		0.050193	3.214654
4500	15		0.050218	3.214626
5000	15		0.050242	3.214599
5500	15		0.050266	3.214571
6000	15		0.050290	3.214543
6500	15		0.050314	3.214515
7000	15		0.050338	3.214487
7500	15		0.050363	3.214459
8000	15		0.050387	3.214431
8500	15		0.050411	3.214403
9000	15		0.050435	3.214375
9500	15		0.050459	3.214347
10000	15		0.050483	3.214319
10500	15		0.050507	3.214291
11000	15		0.050531	3.214263
11500	15		0.050555	3.214234
12000	15		0.050580	3.214206
12500	15		0.050604	3.214178
13000	15		0.050628	3.214150
13500	15		0.050652	3.214122
14000	15		0.050676	3.214094
14500	15		0.050700	3.214066
15000	15		0.050724	3.214037
15500	15		0.050748	3.214009
16000	15		0.050772	3.213981
16500	15		0.050796	3.213953
17000	15		0.050820	3.213925
17500	15		0.050844	3.213896
18000	15		0.050868	3.213868
18500	15		0.050892	3.213840
19000	15		0.050916	3.213811
19500	15		0.050940	3.213783
20000	15		0.050964	3.213755
20500	15		0.050988	3.213727
21000	15		0.051012	3.213698
21500	15		0.051036	3.213670
22000	15		0.051060	3.213641
22500	15		0.051084	3.213613
23000	15		0.051108	3.213585
23500	15		0.051132	3.213556

24000	15	0.051156	3.213528
24500	15	0.051180	3.213500
25000	15	0.051204	3.213471

MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
25500	15		0.051228	3.213443
26000	15		0.051252	3.213414
26500	15		0.051276	3.213386
27000	15		0.051300	3.213357
27500	15		0.051324	3.213329
28000	15		0.051348	3.213300
28500	15		0.051372	3.213272
29000	15		0.051396	3.213244
29500	15		0.051420	3.213215
30000	15		0.051444	3.213187

```
FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No.          0.00  of Load Step No.    6
Step description:
of Block No.     15  of Schedule No.   30000
Crack Size       c =  0.514437E-01
```

C-12 PSE W13 SA227 Tip Extension at End of Outboard Fitting Rear Spar Lower Surface

FATIGUE CRACK GROWTH ANALYSIS
-------Modified by FAI-------
DATE: 17-MAR-99 TIME: 14:29:51
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

PSE-W13, TC03, crack in angle, @ 16,500 lbs

GEOMETRY

MODEL: TC03-Through crack from hole in plate.

Plate Thickness, t = 0.0630
" Width, W = 0.9300
Hole Diameter, D = 0.1900
Hole-Center-to-Edge Dist., B = 0.4300

FLAW SIZE:

c (init.) = 0.5000E-01

MATERIAL

MATL 1: 2024-T3511
Extr; L-T; LA & HHA

Material Properties:

Matl No.	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	77.0	55.0	35.0	25.0	1.00	1.00	0.063	49.6	

Matl No.	Crack Growth Eqn Constants C	n	p	q	DKo	Rcl	Alpha	Smax/SIGo
1	0.200D-07	2.700	0.50	1.00	2.90	0.70	1.50	0.30

MODEL: TC03

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0: 0.0000
Scale Factor for Stress S3: 0.0000

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 2.6800
Scale Factor for Stress S3: 9.1100

C-12 PSE W13 SA227 Tip Extension at End of Outboard Fitting Rear Spar Lower Surface (Continued)

```
Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    2.4000
Scale Factor for Stress S3:    8.9000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    1.8500
Scale Factor for Stress S3:    6.2700

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:   0.51000
Scale Factor for Stress S3:    1.7500

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From    -   To
    1   -      1                         1
    2   -      2                         2
    3   -      3                         5
    4   -      4                         1
    5   -      5                         3
    6   -      6                         5
    7   -      7                         1
    8   -      8                         3
    9   -      9                         5
   10   -     10                         1
   11   -     11                         3
   12   -     12                         5
   13   -     13                         1
   14   -     14                         4
   15   -     15                         5

BLOCK CASE NO.  1
 S  : M:  NUMBER     :         S0          :          S3          :
 T  : A:    OF       :                     :                      :
 E  : T:  FATIGUE    :                     :                      :
 P  : L:  CYCLES     :   (t1) :  (t2)      :   (t1) :   (t2)      :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.90 :   0.70:      1.30:     0.70:      1.30:
   2: 1:        0.09 :   0.60:      1.40:     0.60:      1.40:
   3: 1:        0.01 :   0.54:      1.46:     0.54:      1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER     :         S0          :          S3          :
 T  : A:    OF       :                     :                      :
 E  : T:  FATIGUE    :                     :                      :
 P  : L:  CYCLES     :   (t1) :  (t2)      :   (t1) :   (t2)      :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.00 :   0.78:      0.80:     0.79:      0.81:
   2: 1:       15.09 :   0.57:      1.01:     0.58:      1.02:
   3: 1:        1.52 :   0.36:      1.22:     0.37:      1.23:
   4: 1:        0.23 :   0.14:      1.44:     0.15:      1.45:
   5: 1:        0.05 :  -0.08:      1.66:    -0.07:      1.67:
   6: 1:        0.01 :  -0.29:      1.87:    -0.28:      1.88:
   7: 1:        0.00 :  -0.51:      2.09:    -0.50:      2.10:
   8: 1:        0.00 :  -0.73:      2.31:    -0.72:      2.32:
   9: 1:        0.00 :  -0.94:      2.52:    -0.93:      2.53:
  10: 1:        0.00 :  -1.16:      2.74:    -1.15:      2.75:
```

C-12 PSE W13 SA227 Tip Extension at End of Outboard Fitting Rear Spar Lower Surface (Continued)

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	0.79	0.81	0.79	0.81
2	1	31.10	0.58	1.02	0.58	1.02
3	1	2.98	0.37	1.23	0.37	1.23
4	1	0.45	0.15	1.45	0.15	1.45
5	1	0.09	-0.07	1.67	-0.07	1.67
6	1	0.02	-0.28	1.88	-0.28	1.88
7	1	0.01	-0.50	2.10	-0.50	2.10
8	1	0.00	-0.72	2.32	-0.72	2.32
9	1	0.00	-0.93	2.53	-0.93	2.53
10	1	0.00	-1.15	2.75	-1.15	2.75

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.00	0.99	1.01	0.99	1.01
2	1	24.52	0.78	1.22	0.78	1.22
3	1	2.73	0.57	1.43	0.57	1.43
4	1	0.46	0.35	1.65	0.35	1.65
5	1	0.11	0.13	1.87	0.13	1.87
6	1	0.03	-0.08	2.08	-0.08	2.08
7	1	0.01	-0.30	2.30	-0.30	2.30
8	1	0.00	-0.52	2.52	-0.52	2.52
9	1	0.00	-0.73	2.73	-0.73	2.73
10	1	0.00	-0.95	2.95	-0.95	2.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT'L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.00	1.74	0.00	1.74
3	1	0.22	-1.00	2.48	-1.00	2.48
4	1	0.06	-2.00	3.22	-2.00	3.22
5	1	0.00	-3.00	3.96	-3.00	3.96
6	1	0.00	-4.00	4.70	-4.00	4.70

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W13, TC03, crack in ang
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

C-12 PSE W13 SA227 Tip Extension at End of Outboard Fitting Rear Spar Lower Surface (Continued)

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W13, TC03, crack in ang
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.00	2.09	2.14	7.20	7.38
2	1	15.09	1.53	2.71	5.28	9.29
3	1	1.52	0.96	3.27	3.37	11.21
4	1	0.23	0.38	3.86	1.37	13.21
5	1	0.05	-0.21	4.45	-0.64	15.21
6	1	0.01	-0.78	5.01	-2.55	17.13
7	1	0.00	-1.37	5.60	-4.55	19.13
8	1	0.00	-1.96	6.19	-6.56	21.14
9	1	0.00	-2.52	6.75	-8.47	23.05
10	1	0.00	-3.11	7.34	-10.48	25.05

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W13, TC03, crack in ang
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.00	1.90	1.94	7.03	7.21
2	1	31.10	1.39	2.45	5.16	9.08
3	1	2.98	0.89	2.95	3.29	10.95
4	1	0.45	0.36	3.48	1.34	12.91
5	1	0.09	-0.17	4.01	-0.62	14.86
6	1	0.02	-0.67	4.51	-2.49	16.73
7	1	0.01	-1.20	5.04	-4.45	18.69
8	1	0.00	-1.73	5.57	-6.41	20.65
9	1	0.00	-2.23	6.07	-8.28	22.52
10	1	0.00	-2.76	6.60	-10.23	24.48

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W13, TC03, crack in ang
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.00	1.83	1.87	6.21	6.33
2	1	24.52	1.44	2.26	4.89	7.65
3	1	2.73	1.05	2.65	3.57	8.97
4	1	0.46	0.65	3.05	2.19	10.35
5	1	0.11	0.24	3.46	0.82	11.72
6	1	0.03	-0.15	3.85	-0.50	13.04
7	1	0.01	-0.56	4.25	-1.88	14.42
8	1	0.00	-0.96	4.66	-3.26	15.80
9	1	0.00	-1.35	5.05	-4.58	17.12
10	1	0.00	-1.76	5.46	-5.96	18.50

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W13, TC03, crack in ang
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	0.51	0.52	1.75	1.77
2	1	0.44	0.00	0.89	0.00	3.04
3	1	0.22	-0.51	1.26	-1.75	4.34
4	1	0.06	-1.02	1.64	-3.50	5.64
5	1	0.00	-1.53	2.02	-5.25	6.93
6	1	0.00	-2.04	2.40	-7.00	8.22

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE-W13, TC03, crack in ang
MODEL: TC03

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
500	15		0.052148	3.499047
1000	15		0.054286	3.498362
1500	15		0.056412	3.497561
2000	15		0.058528	3.496728
2500	15		0.060633	3.495930
3000	15		0.062728	3.495220
3500	15		0.064815	3.494640
4000	15		0.066894	3.494226
4500	15		0.068965	3.494004
5000	15		0.071030	3.493998
5500	15		0.073090	3.494224
6000	15		0.075145	3.494697
6500	15		0.077198	3.495430
7000	15		0.079248	3.496432
7500	15		0.081297	3.497713

C-12 PSE W13 SA227 Tip Extension at End of Outboard Fitting Rear Spar Lower Surface (Continued)

8000	15	0.083346	3.499279
8500	15	0.085396	3.501138
9000	15	0.087448	3.503295
9500	15	0.089504	3.505757
10000	15	0.091564	3.508529
10500	15	0.093630	3.511618
11000	15	0.095702	3.515031
11500	15	0.097782	3.518773
12000	15	0.099872	3.522853
12500	15	0.101972	3.527277
13000	15	0.104083	3.532055
13500	15	0.106207	3.537196
14000	15	0.108345	3.542711
14500	15	0.110499	3.548609
15000	15	0.112669	3.554905
15500	15	0.114858	3.561611
16000	15	0.117067	3.568743
16500	15	0.119296	3.576317
17000	15	0.121548	3.584351
17500	15	0.123825	3.592865
18000	15	0.126128	3.601882
18500	15	0.128459	3.611426
19000	15	0.130820	3.621524
19500	15	0.133212	3.632205
20000	15	0.135639	3.643502
20500	15	0.138102	3.655451
21000	15	0.140604	3.668094
21500	15	0.143147	3.681474
22000	15	0.145734	3.695642
22500	15	0.148368	3.710655
23000	15	0.151053	3.726574
23500	15	0.153798	3.743508
24000	15	0.156619	3.761625
24500	15	0.159514	3.780983
25000	15	0.162486	3.801687

MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
25500	15		0.165540	3.823864
26000	15		0.168682	3.847663
26500	15		0.171919	3.873261
27000	15		0.175258	3.900864
27500	15		0.178710	3.930719
28000	15		0.182284	3.963118
28500	15		0.185994	3.998417
29000	15		0.189853	4.037048
29500	15		0.193880	4.079546
30000	15		0.198094	4.126581
30500	15		0.202522	4.179009
31000	15		0.207195	4.237941
31500	15		0.212152	4.304859
32000	15		0.217444	4.381790
32500	15		0.223138	4.471603
33000	15		0.229326	4.578543
33500	15		0.236140	4.709234
34000	15		0.243784	4.874933
34500	15		0.252591	5.096490
35000	15		0.263183	5.419519

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or

C-12 PSE W13 SA227 Tip Extension at End of Outboard Fitting Rear Spar Lower Surface (Continued)

```
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.   10
Step description:
of Block No.      2  of Schedule No.   35123
Crack Size     c =  0.266172
  35500       15              0.277021                 5.976884

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No.   10
Step description:
of Block No.      2  of Schedule No.   35613
Crack Size     c =  0.280926
```

C-13 PSE W14 SA227 Tip Extension at End of Outboard Fitting Main Spar Lower Surface

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    ------modified by FAI--------
                   DATE: 25-SEP-97   TIME: 15:21:53
           (computed: NASA/FLAGRO Version 2.03, March 1995.)
           U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC-3, PSE-W14 crack in angle, Main Spar Lower

GEOMETRY
--------
MODEL: TC03-Through crack from hole in plate.

Plate Thickness, t =    0.1250
  "   Width, W     =    0.7500
Hole Diameter, D   =    0.1900
Hole-Center-to-Edge Dist., B =    0.3750

FLAW SIZE:

c   (init.) =  0.5000E-01



MATERIAL
--------

MATL 1: 2014-T6
        Plt & sht; L-T

Material Properties:

:Matl:  UTS :  YS   :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :       :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  74.0:  65.0:  38.0:  27.0: 1.00: 1.00:  0.125:  51.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.350D-07:2.800:0.50:1.00:  2.70:  0.70: 1.50: 0.30:
TC-3, PSE-W14 crack in angle, Main Spar Lower
MODEL: TC03

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    0.0000
Scale Factor for Stress S3:    0.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:   0.36000
Scale Factor for Stress S3:    2.8300
```

C-13 PSE W14 SA227 Tip Extension at End of Outboard Fitting Main Spar Lower Surface (Continued)

```
Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:   0.37000
Scale Factor for Stress S3:    2.9300
Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:   0.41000
Scale Factor for Stress S3:    3.2600

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:   0.27000
Scale Factor for Stress S3:    2.1100

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                    Block Case No.
From    -    To
    1   -     1                          1
    2   -     2                          2
    3   -     3                          5
    4   -     4                          1
    5   -     5                          3
    6   -     6                          5
    7   -     7                          1
    8   -     8                          3
    9   -     9                          5
   10   -    10                          1
   11   -    11                          3
   12   -    12                          5
   13   -    13                          1
   14   -    14                          4
   15   -    15                          5

BLOCK CASE NO.  1
 S  : M:  NUMBER     :        S0          :        S3          :
 T  : A:    OF       :                    :                    :
 E  : T:  FATIGUE    :                    :                    :
 P  : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        0.90 :   -0.35:     2.35:   -0.35:     2.35:
   2: 1:        0.09 :   -0.40:     2.40:   -0.40:     2.40:
   3: 1:        0.01 :   -0.46:     2.46:   -0.46:     2.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER     :        S0          :        S3          :
 T  : A:    OF       :                    :                    :
 E  : T:  FATIGUE    :                    :                    :
 P  : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        9.57 :    0.45:     1.05:    0.45:     1.05:
   2: 1:        1.14 :    0.25:     1.25:    0.25:     1.25:
   3: 1:        0.57 :    0.15:     1.35:    0.15:     1.35:
   4: 1:        0.11 :   -0.05:     1.55:   -0.05:     1.55:
   5: 1:        0.02 :   -0.25:     1.75:   -0.25:     1.75:
   6: 1:        0.01 :   -0.45:     1.95:   -0.45:     1.95:
   7: 1:        0.00 :   -0.65:     2.15:   -0.65:     2.15:
   8: 1:        0.00 :   -0.85:     2.35:   -0.85:     2.35:
   9: 1:        0.00 :   -1.05:     2.55:   -1.05:     2.55:
  10: 1:        0.00 :   -1.25:     2.75:   -1.25:     2.75:

Environmental Crack Growth Check for Sustained Stresses
```

C-13 PSE W14 SA227 Tip Extension at End of Outboard Fitting Main Spar Lower Surface (Continued)

(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0		S3	
			(t1)	(t2)	(t1)	(t2)
1	1	19.14	0.46	1.06	0.45	1.05
2	1	2.29	0.26	1.26	0.25	1.25
3	1	1.14	0.16	1.36	0.15	1.35
4	1	0.23	-0.04	1.56	-0.05	1.55
5	1	0.04	-0.24	1.76	-0.25	1.75
6	1	0.01	-0.44	1.96	-0.45	1.95
7	1	0.00	-0.64	2.16	-0.65	2.15
8	1	0.00	-0.84	2.36	-0.85	2.35
9	1	0.00	-1.04	2.56	-1.05	2.55
10	1	0.00	-1.24	2.76	-1.25	2.75

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0		S3	
			(t1)	(t2)	(t1)	(t2)
1	1	38.29	0.46	1.06	0.45	1.05
2	1	4.57	0.26	1.26	0.25	1.25
3	1	1.14	0.16	1.36	0.15	1.35
4	1	0.46	-0.04	1.56	-0.05	1.55
5	1	0.08	-0.24	1.76	-0.25	1.75
6	1	0.02	-0.44	1.96	-0.45	1.95
7	1	0.01	-0.64	2.16	-0.65	2.15
8	1	0.00	-0.84	2.36	-0.85	2.35
9	1	0.00	-1.04	2.56	-1.05	2.55
10	1	0.00	-1.24	2.76	-1.25	2.75

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0		S3	
			(t1)	(t2)	(t1)	(t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	0.80	1.10	0.80	1.10
3	1	0.22	0.60	1.20	0.60	1.20
4	1	0.06	0.40	1.30	0.40	1.30
5	1	0.00	0.20	1.40	0.20	1.40
6	1	0.00	0.00	1.50	0.00	1.50

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC-3, PSE-W14 crack in angle, Main Spar Lower
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

C-13 PSE W14 SA227 Tip Extension at End of Outboard Fitting Main Spar Lower Surface (Continued)

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC-3, PSE-W14 crack in angle, Main Spar Lower
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	0.16	0.38	1.27	2.97
2	1	1.14	0.09	0.45	0.71	3.54
3	1	0.57	0.05	0.49	0.42	3.82
4	1	0.11	-0.02	0.56	-0.14	4.39
5	1	0.02	-0.09	0.63	-0.71	4.95
6	1	0.01	-0.16	0.70	-1.27	5.52
7	1	0.00	-0.23	0.77	-1.84	6.08
8	1	0.00	-0.31	0.85	-2.41	6.65
9	1	0.00	-0.38	0.92	-2.97	7.22
10	1	0.00	-0.45	0.99	-3.54	7.78

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC-3, PSE-W14 crack in angle, Main Spar Lower
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	0.17	0.39	1.32	3.08
2	1	2.29	0.10	0.47	0.73	3.66
3	1	1.14	0.06	0.50	0.44	3.96
4	1	0.23	-0.01	0.58	-0.15	4.54
5	1	0.04	-0.09	0.65	-0.73	5.13
6	1	0.01	-0.16	0.73	-1.32	5.71
7	1	0.00	-0.24	0.80	-1.90	6.30
8	1	0.00	-0.31	0.87	-2.49	6.89
9	1	0.00	-0.38	0.95	-3.08	7.47
10	1	0.00	-0.46	1.02	-3.66	8.06

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC-3, PSE-W14 crack in angle, Main Spar Lower
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

C-13 PSE W14 SA227 Tip Extension at End of Outboard Fitting Main Spar Lower Surface (Continued)

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	0.19	0.43	1.47	3.42
2	1	4.57	0.11	0.52	0.81	4.07
3	1	1.14	0.07	0.56	0.49	4.40
4	1	0.46	-0.02	0.64	-0.16	5.05
5	1	0.08	-0.10	0.72	-0.81	5.71
6	1	0.02	-0.18	0.80	-1.47	6.36
7	1	0.01	-0.26	0.89	-2.12	7.01
8	1	0.00	-0.34	0.97	-2.77	7.66
9	1	0.00	-0.43	1.05	-3.42	8.31
10	1	0.00	-0.51	1.13	-4.07	8.96

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC-3, PSE-W14 crack in angle, Main Spar Lower
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	0.27	0.27	2.11	2.13
2	1	0.44	0.22	0.30	1.69	2.32
3	1	0.22	0.16	0.32	1.27	2.53
4	1	0.06	0.11	0.35	0.84	2.74
5	1	0.00	0.05	0.38	0.42	2.95
6	1	0.00	0.00	0.41	0.00	3.17

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC-3, PSE-W14 crack in angle, Main Spar Lower
MODEL: TC03

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
1000	15		0.050000	1.054599
2000	15		0.050001	1.054599
3000	15		0.050001	1.054598
4000	15		0.050002	1.054598
5000	15		0.050002	1.054598
6000	15		0.050003	1.054598
7000	15		0.050003	1.054597
8000	15		0.050004	1.054597
9000	15		0.050004	1.054597
10000	15		0.050005	1.054597
11000	15		0.050005	1.054596
12000	15		0.050005	1.054596
13000	15		0.050006	1.054596
14000	15		0.050006	1.054596
15000	15		0.050007	1.054595
16000	15		0.050007	1.054595

C-13 PSE W14 SA227 Tip Extension at End of Outboard Fitting Main Spar Lower Surface (Continued)

17000	15	0.050008	1.054595
18000	15	0.050008	1.054595
19000	15	0.050009	1.054594
20000	15	0.050009	1.054594
21000	15	0.050010	1.054594

```
FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No.          0.00  of Load Step No.     6
Step description:
of Block No.      15  of Schedule No.   21000
Crack Size      c =  0.500096E-01
```

C-14 PSE EM1 Upper Engine Mount at Firewall

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    -----------------------------
                 DATE: 09/10/98     TIME: 09:52:05
         (computed: NASA/FLAGRO Version 2.03, March 1995.)
         U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate pre S/B

GEOMETRY
--------
MODEL: TC01-Through crack in center of plate.

Plate Thickness, t =    0.1250
  "   Width, W     =    2.4500

FLAW SIZE:

c   (init.) =  0.2500E-01



MATERIAL
--------

MATL 1:
       1       4130N

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 : 140.0: 120.0: 190.0: 135.0: 0.75: 0.50:  0.125: 202.4:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.170E-08:2.700:0.25:0.25:  6.00:  0.70: 2.50: 0.30:
 THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate pre S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    28.680

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    28.680
```

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

```
Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    28.680

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    28.680

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    28.680

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
    1   -     1                        1
    2   -     2                        2
    3   -     3                        5
    4   -     4                        1
    5   -     5                        3
    6   -     6                        5
    7   -     7                        1
    8   -     8                        3
    9   -     9                        5
   10   -    10                        1
   11   -    11                        3
   12   -    12                        5
   13   -    13                        1
   14   -    14                        4
   15   -    15                        5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :         S0          :         S1          :
 T   : A:    OF        :                     :                     :
 E   : T:  FATIGUE     :                     :                     :
 P   : L:  CYCLES      :    (t1) :  (t2)     :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :   -0.30:      0.30:     1.91:      2.51:
   2: 1:         0.09 :   -0.40:      0.40:     1.81:      2.61:
   3: 1:         0.01 :   -0.46:      0.46:     1.75:      2.67:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S   : M:  NUMBER      :         S0          :         S1          :
 T   : A:    OF        :                     :                     :
 E   : T:  FATIGUE     :                     :                     :
 P   : L:  CYCLES      :    (t1) :  (t2)     :    (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :   -0.30:      0.30:     1.91:      2.51:
   2: 1:         1.14 :   -0.50:      0.50:     1.71:      2.71:
   3: 1:         0.57 :   -0.60:      0.60:     1.61:      2.81:
   4: 1:         0.11 :   -0.80:      0.80:     1.41:      3.01:
   5: 1:         0.02 :   -1.00:      1.00:     1.21:      3.21:
   6: 1:         0.01 :   -1.20:      1.20:     1.01:      3.41:
   7: 1:         0.00 :   -1.40:      1.40:     0.81:      3.61:
   8: 1:         0.00 :   -1.60:      1.60:     0.61:      3.81:
   9: 1:         0.00 :   -1.80:      1.80:     0.41:      4.01:
  10: 1:         0.00 :   -2.00:      2.00:     0.21:      4.21:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
```

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	-0.30	0.30	1.91	2.51
2	1	2.29	-0.50	0.50	1.71	2.71
3	1	1.14	-0.60	0.60	1.61	2.81
4	1	0.23	-0.80	0.80	1.41	3.01
5	1	0.04	-1.00	1.00	1.21	3.21
6	1	0.01	-1.20	1.20	1.01	3.41
7	1	0.00	-1.40	1.40	0.81	3.61
8	1	0.00	-1.60	1.60	0.61	3.81
9	1	0.00	-1.80	1.80	0.41	4.01
10	1	0.00	-2.00	2.00	0.21	4.21

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	-0.30	0.30	1.91	2.51
2	1	4.57	-0.50	0.50	1.71	2.71
3	1	2.29	-0.60	0.60	1.61	2.81
4	1	0.46	-0.80	0.80	1.41	3.01
5	1	0.08	-1.00	1.00	1.21	3.21
6	1	0.02	-1.20	1.20	1.01	3.41
7	1	0.01	-1.40	1.40	0.81	3.61
8	1	0.00	-1.60	1.60	0.61	3.81
9	1	0.00	-1.80	1.80	0.41	4.01
10	1	0.00	-2.00	2.00	0.21	4.21

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	-0.55	0.55	1.66	2.76
2	1	0.44	-0.57	0.57	1.64	2.78
3	1	0.22	-0.62	0.62	1.59	2.83
4	1	0.06	-0.70	0.70	1.51	2.91
5	1	0.00	-0.82	0.82	1.39	3.03
6	1	0.00	-0.98	0.98	1.23	3.19

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate pre S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STE…	MAT…	NUMBER OF FATIGUE	S0 (ksi)	S1 (ksi)

P : L:	CYCLES :	(t1) :	(t2) :	(t1) :	(t2) :
1: 1:	1.90 :	0.00:	0.00:	54.78:	71.99:
2: 1:	0.09 :	0.00:	0.00:	51.91:	74.85:
3: 1:	0.01 :	0.00:	0.00:	50.19:	76.58:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate pre S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	(t2)	S1 (ksi) (t1)	(t2)
1:	1:	9.57 :	0.00:	0.00:	54.78:	71.99:
2:	1:	1.14 :	0.00:	0.00:	49.04:	77.72:
3:	1:	0.57 :	0.00:	0.00:	46.17:	80.59:
4:	1:	0.11 :	0.00:	0.00:	40.44:	86.33:
5:	1:	0.02 :	0.00:	0.00:	34.70:	92.06:
6:	1:	0.01 :	0.00:	0.00:	28.97:	97.80:
7:	1:	0.00 :	0.00:	0.00:	23.23:	103.53:
8:	1:	0.00 :	0.00:	0.00:	17.49:	109.27:
9:	1:	0.00 :	0.00:	0.00:	11.76:	115.01:
10:	1:	0.00 :	0.00:	0.00:	6.02:	120.74:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate pre S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	(t2)	S1 (ksi) (t1)	(t2)
1:	1:	19.14 :	0.00:	0.00:	54.78:	71.99:
2:	1:	2.29 :	0.00:	0.00:	49.04:	77.72:
3:	1:	1.14 :	0.00:	0.00:	46.17:	80.59:
4:	1:	0.23 :	0.00:	0.00:	40.44:	86.33:
5:	1:	0.04 :	0.00:	0.00:	34.70:	92.06:
6:	1:	0.01 :	0.00:	0.00:	28.97:	97.80:
7:	1:	0.00 :	0.00:	0.00:	23.23:	103.53:
8:	1:	0.00 :	0.00:	0.00:	17.49:	109.27:
9:	1:	0.00 :	0.00:	0.00:	11.76:	115.01:
10:	1:	0.00 :	0.00:	0.00:	6.02:	120.74:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate pre S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD S T E P	M: A: T: L:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	(t2)	S1 (ksi) (t1)	(t2)

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

1:	1:	38.29 :	0.00:	0.00:	54.78:	71.99:
2:	1:	4.57 :	0.00:	0.00:	49.04:	77.72:
3:	1:	2.29 :	0.00:	0.00:	46.17:	80.59:
4:	1:	0.46 :	0.00:	0.00:	40.44:	86.33:
5:	1:	0.08 :	0.00:	0.00:	34.70:	92.06:
6:	1:	0.02 :	0.00:	0.00:	28.97:	97.80:
7:	1:	0.01 :	0.00:	0.00:	23.23:	103.53:
8:	1:	0.00 :	0.00:	0.00:	17.49:	109.27:
9:	1:	0.00 :	0.00:	0.00:	11.76:	115.01:
10:	1:	0.00 :	0.00:	0.00:	6.02:	120.74:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate pre S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT:	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28 :	0.00:	0.00:	47.61:	79.16:
2:	1:	0.44 :	0.00:	0.00:	47.04:	79.73:
3:	1:	0.22 :	0.00:	0.00:	45.60:	81.16:
4:	1:	0.06 :	0.00:	0.00:	43.31:	83.46:
5:	1:	0.00 :	0.00:	0.00:	39.87:	86.90:
6:	1:	0.00 :	0.00:	0.00:	35.28:	91.49:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate pre S/B
MODEL: TC01

ANALYSIS RESULTS:

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No. 10
Step description:
of Block No. 2 of Schedule No. 1
Crack Size c = 0.250003E-01

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.025692	12.999676
400	15		0.026417	13.182037
600	15		0.027177	13.370504
800	15		0.027974	13.565314
1000	15		0.028809	13.766722
1200	15		0.029687	13.975001
1400	15		0.030607	14.190441
1600	15		0.031575	14.413353
1800	15		0.032592	14.644066
2000	15		0.033662	14.882936
2200	15		0.034788	15.130340
2400	15		0.035975	15.386680
2600	15		0.037225	15.652387
2800	15		0.038544	15.927924
3000	15		0.039936	16.213784

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

3200	15	0.041407	16.510495
3400	15	0.042963	16.818626
3600	15	0.044609	17.138787
3800	15	0.046352	17.471633
4000	15	0.048201	17.817871
4200	15	0.050162	18.178263
4400	15	0.052246	18.553631
4600	15	0.054462	18.944865
4800	15	0.056821	19.352931
5000	15	0.059336	19.778876
5200	15	0.062019	20.223840
5400	15	0.064885	20.689068
5600	15	0.067952	21.175919
5800	15	0.071238	21.685884
6000	15	0.074762	22.220602
6200	15	0.078549	22.781880
6400	15	0.082625	23.371716
6600	15	0.087017	23.992332

```
FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No.   10
Step description:
of Block No.       8  of Schedule No.    6610
Crack Size      c =  0.872335E-01

                    FATIGUE CRACK GROWTH ANALYSIS
                    -----------------------------
                  DATE: 09/10/98    TIME: 13:45:26
           (computed: NASA/FLAGRO Version 2.03, March 1995.)
           U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate post S/B

GEOMETRY
--------
MODEL: TC01-Through crack in center of plate.

Plate Thickness, t =    0.1250
  "   Width, W     =    3.9300

FLAW SIZE:

c   (init.) =  0.2500E-01



MATERIAL
--------

MATL 1:
        1       4130N

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  95.0:  75.0: 190.0: 135.0: 0.75: 0.50:  0.125: 202.4:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p  :  q  :  DKo  :  Rcl :Alpha:Smax/:
:    :           :     :     :     :       :      :     :SIGo :
```

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

```
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.170E-08:2.700:0.25:0.25:  6.00:  0.70: 2.50: 0.30:
 THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate post S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    5.6800

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    5.6800

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    5.6800

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    5.6800

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    5.6800

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                    Block Case No.
From    -    To
    1   -     1                        1
    2   -     2                        2
    3   -     3                        5
    4   -     4                        1
    5   -     5                        3
    6   -     6                        5
    7   -     7                        1
    8   -     8                        3
    9   -     9                        5
   10   -    10                        1
   11   -    11                        3
   12   -    12                        5
   13   -    13                        1
   14   -    14                        4
   15   -    15                        5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :          S0          :          S1          :
 T  : A:    OF        :                      :                      :
 E  : T:  FATIGUE     :                      :                      :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :   -0.30:     0.30:     1.91:     2.51:
   2: 1:         0.09 :   -0.40:     0.40:     1.81:     2.61:
   3: 1:         0.01 :   -0.46:     0.46:     1.75:     2.67:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
```

BLOCK CASE NO. 2

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	9.57	-0.30	0.30	1.91	2.51
2	1	1.14	-0.50	0.50	1.71	2.71
3	1	0.57	-0.60	0.60	1.61	2.81
4	1	0.11	-0.80	0.80	1.41	3.01
5	1	0.02	-1.00	1.00	1.21	3.21
6	1	0.01	-1.20	1.20	1.01	3.41
7	1	0.00	-1.40	1.40	0.81	3.61
8	1	0.00	-1.60	1.60	0.61	3.81
9	1	0.00	-1.80	1.80	0.41	4.01
10	1	0.00	-2.00	2.00	0.21	4.21

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	-0.30	0.30	1.91	2.51
2	1	2.29	-0.50	0.50	1.71	2.71
3	1	1.14	-0.60	0.60	1.61	2.81
4	1	0.23	-0.80	0.80	1.41	3.01
5	1	0.04	-1.00	1.00	1.21	3.21
6	1	0.01	-1.20	1.20	1.01	3.41
7	1	0.00	-1.40	1.40	0.81	3.61
8	1	0.00	-1.60	1.60	0.61	3.81
9	1	0.00	-1.80	1.80	0.41	4.01
10	1	0.00	-2.00	2.00	0.21	4.21

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	38.29	-0.30	0.30	1.91	2.51
2	1	4.57	-0.50	0.50	1.71	2.71
3	1	2.29	-0.60	0.60	1.61	2.81
4	1	0.46	-0.80	0.80	1.41	3.01
5	1	0.08	-1.00	1.00	1.21	3.21
6	1	0.02	-1.20	1.20	1.01	3.41
7	1	0.01	-1.40	1.40	0.81	3.61
8	1	0.00	-1.60	1.60	0.61	3.81
9	1	0.00	-1.80	1.80	0.41	4.01
10	1	0.00	-2.00	2.00	0.21	4.21

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE	S0	S1

P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	0.28	-0.55:	0.55:	1.66:	2.76:
2:	1:	0.44	-0.57:	0.57:	1.64:	2.78:
3:	1:	0.22	-0.62:	0.62:	1.59:	2.83:
4:	1:	0.06	-0.70:	0.70:	1.51:	2.91:
5:	1:	0.00	-0.82:	0.82:	1.39:	3.03:
6:	1:	0.00	-0.98:	0.98:	1.23:	3.19:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate post S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	1.90	0.00:	0.00:	10.85:	14.26:
2:	1:	0.09	0.00:	0.00:	10.28:	14.82:
3:	1:	0.01	0.00:	0.00:	9.94:	15.17:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate post S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	9.57	0.00:	0.00:	10.85:	14.26:
2:	1:	1.14	0.00:	0.00:	9.71:	15.39:
3:	1:	0.57	0.00:	0.00:	9.14:	15.96:
4:	1:	0.11	0.00:	0.00:	8.01:	17.10:
5:	1:	0.02	0.00:	0.00:	6.87:	18.23:
6:	1:	0.01	0.00:	0.00:	5.74:	19.37:
7:	1:	0.00	0.00:	0.00:	4.60:	20.50:
8:	1:	0.00	0.00:	0.00:	3.46:	21.64:
9:	1:	0.00	0.00:	0.00:	2.33:	22.78:
10:	1:	0.00	0.00:	0.00:	1.19:	23.91:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate post S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	19.14	0.00:	0.00:	10.85:	14.26:
2:	1:	2.29	0.00:	0.00:	9.71:	15.39:
3:	1:	1.14	0.00:	0.00:	9.14:	15.96:

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

4:	1:	0.23 :	0.00:	0.00:	8.01:	17.10:
5:	1:	0.04 :	0.00:	0.00:	6.87:	18.23:
6:	1:	0.01 :	0.00:	0.00:	5.74:	19.37:
7:	1:	0.00 :	0.00:	0.00:	4.60:	20.50:
8:	1:	0.00 :	0.00:	0.00:	3.46:	21.64:
9:	1:	0.00 :	0.00:	0.00:	2.33:	22.78:
10:	1:	0.00 :	0.00:	0.00:	1.19:	23.91:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate post S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	38.29 :	0.00:	0.00:	10.85:	14.26:
2:	1:	4.57 :	0.00:	0.00:	9.71:	15.39:
3:	1:	2.29 :	0.00:	0.00:	9.14:	15.96:
4:	1:	0.46 :	0.00:	0.00:	8.01:	17.10:
5:	1:	0.08 :	0.00:	0.00:	6.87:	18.23:
6:	1:	0.02 :	0.00:	0.00:	5.74:	19.37:
7:	1:	0.01 :	0.00:	0.00:	4.60:	20.50:
8:	1:	0.00 :	0.00:	0.00:	3.46:	21.64:
9:	1:	0.00 :	0.00:	0.00:	2.33:	22.78:
10:	1:	0.00 :	0.00:	0.00:	1.19:	23.91:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate post S/B
MODEL: TC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28 :	0.00:	0.00:	9.43:	15.68:
2:	1:	0.44 :	0.00:	0.00:	9.32:	15.79:
3:	1:	0.22 :	0.00:	0.00:	9.03:	16.07:
4:	1:	0.06 :	0.00:	0.00:	8.58:	16.53:
5:	1:	0.00 :	0.00:	0.00:	7.90:	17.21:
6:	1:	0.00 :	0.00:	0.00:	6.99:	18.12:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 1, PSE-EM1 Crack in mount plate post S/B
MODEL: TC01

ANALYSIS RESULTS:

FINAL RESULTS:
All Stress Intensities are below the Fatigue Threshold.
NO growth in Schedule No. 1
Crack Size c = 0.250000E-01

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    -----------------------------
                 DATE: 09/10/98    TIME: 13:46:03
         (computed: NASA/FLAGRO Version 2.03, March 1995.)
         U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 8, PSE-EM1 Crack in weld pre S/B

GEOMETRY
--------
MODEL: TC08-Through crack in cyl. in circumferential directio

Mean Radius of cylinder, R =     0.7975
Thickness of cylinder, t   =     0.2050
Poisson s Ratio            =     0.3300

FLAW SIZE:

c   (init.) =  0.2500E-01




MATERIAL
--------

MATL 1:
        1       4130N

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 : 140.0: 120.0: 190.0: 135.0: 0.75: 0.50:  0.205: 202.3:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p  :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :     :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.170E-08:2.700:0.25:0.25:  6.00:  0.70: 2.50: 0.30:
 THROUGH CRACK CASE 8, PSE-EM1 Crack in weld pre S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    7.9700
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    7.9700
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    7.9700
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  4
```

```
Scale Factor for Stress S0:    7.9700
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    7.9700
Scale Factor for Stress S1:   0.00000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                     Block Case No.
From   -   To
    1   -      1                         1
    2   -      2                         2
    3   -      3                         5
    4   -      4                         1
    5   -      5                         3
    6   -      6                         5
    7   -      7                         1
    8   -      8                         3
    9   -      9                         5
   10   -     10                         1
   11   -     11                         3
   12   -     12                         5
   13   -     13                         1
   14   -     14                         4
   15   -     15                         5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :        S0          :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         1.90 :    1.91:     2.51:    -0.30:     0.30:
   2: 1:         0.09 :    1.81:     2.61:    -0.40:     0.40:
   3: 1:         0.01 :    1.75:     2.67:    -0.46:     0.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER      :        S0          :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:--------------:---------:---------:---------:---------:
   1: 1:         9.57 :    1.91:     2.51:    -0.30:     0.30:
   2: 1:         1.14 :    1.71:     2.71:    -0.50:     0.50:
   3: 1:         0.57 :    1.61:     2.81:    -0.60:     0.60:
   4: 1:         0.11 :    1.41:     3.01:    -0.80:     0.80:
   5: 1:         0.02 :    1.21:     3.21:    -1.00:     1.00:
   6: 1:         0.01 :    1.01:     3.41:    -1.20:     1.20:
   7: 1:         0.00 :    0.81:     3.61:    -1.40:     1.40:
   8: 1:         0.00 :    0.61:     3.81:    -1.60:     1.60:
   9: 1:         0.00 :    0.41:     4.01:    -1.80:     1.80:
  10: 1:         0.00 :    0.21:     4.21:    -2.00:     2.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S  : M:  NUMBER      :        S0          :        S1          :
 T  : A:    OF        :                    :                    :
 E  : T:  FATIGUE     :                    :                    :
```

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	19.14	1.91	2.51	-0.30	0.30
2	1	2.29	1.71	2.71	-0.50	0.50
3	1	1.14	1.61	2.81	-0.60	0.60
4	1	0.23	1.41	3.01	-0.80	0.80
5	1	0.04	1.21	3.21	-1.00	1.00
6	1	0.01	1.01	3.41	-1.20	1.20
7	1	0.00	0.81	3.61	-1.40	1.40
8	1	0.00	0.61	3.81	-1.60	1.60
9	1	0.00	0.41	4.01	-1.80	1.80
10	1	0.00	0.21	4.21	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0		S1	
			(t1)	(t2)	(t1)	(t2)
1	1	38.29	1.91	2.51	-0.30	0.30
2	1	4.57	1.71	2.71	-0.50	0.50
3	1	2.29	1.61	2.81	-0.60	0.60
4	1	0.46	1.41	3.01	-0.80	0.80
5	1	0.08	1.21	3.21	-1.00	1.00
6	1	0.02	1.01	3.41	-1.20	1.20
7	1	0.01	0.81	3.61	-1.40	1.40
8	1	0.00	0.61	3.81	-1.60	1.60
9	1	0.00	0.41	4.01	-1.80	1.80
10	1	0.00	0.21	4.21	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0		S1	
			(t1)	(t2)	(t1)	(t2)
1	1	0.28	1.66	2.76	-0.55	0.55
2	1	0.44	1.64	2.78	-0.57	0.57
3	1	0.22	1.59	2.83	-0.62	0.62
4	1	0.06	1.51	2.91	-0.70	0.70
5	1	0.00	1.39	3.03	-0.82	0.82
6	1	0.00	1.23	3.19	-0.98	0.98

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld pre S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi)		S1 (ksi)	
			(t1)	(t2)	(t1)	(t2)
1	1	1.90	15.22	20.00	0.00	0.00
2	1	0.09	14.43	20.80	0.00	0.00
3	1	0.01	13.95	21.28	0.00	0.00

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld pre S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	15.22	20.00	0.00	0.00
2	1	1.14	13.63	21.60	0.00	0.00
3	1	0.57	12.83	22.40	0.00	0.00
4	1	0.11	11.24	23.99	0.00	0.00
5	1	0.02	9.64	25.58	0.00	0.00
6	1	0.01	8.05	27.18	0.00	0.00
7	1	0.00	6.46	28.77	0.00	0.00
8	1	0.00	4.86	30.37	0.00	0.00
9	1	0.00	3.27	31.96	0.00	0.00
10	1	0.00	1.67	33.55	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld pre S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	15.22	20.00	0.00	0.00
2	1	2.29	13.63	21.60	0.00	0.00
3	1	1.14	12.83	22.40	0.00	0.00
4	1	0.23	11.24	23.99	0.00	0.00
5	1	0.04	9.64	25.58	0.00	0.00
6	1	0.01	8.05	27.18	0.00	0.00
7	1	0.00	6.46	28.77	0.00	0.00
8	1	0.00	4.86	30.37	0.00	0.00
9	1	0.00	3.27	31.96	0.00	0.00
10	1	0.00	1.67	33.55	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld pre S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	15.22	20.00	0.00	0.00
2	1	4.57	13.63	21.60	0.00	0.00
3	1	2.29	12.83	22.40	0.00	0.00
4	1	0.46	11.24	23.99	0.00	0.00
5	1	0.08	9.64	25.58	0.00	0.00

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

6:	1:	0.02 :	8.05:	27.18:	0.00:	0.00:
7:	1:	0.01 :	6.46:	28.77:	0.00:	0.00:
8:	1:	0.00 :	4.86:	30.37:	0.00:	0.00:
9:	1:	0.00 :	3.27:	31.96:	0.00:	0.00:
10:	1:	0.00 :	1.67:	33.55:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld pre S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1:	1:	0.28 :	13.23:	22.00:	0.00:	0.00:
2:	1:	0.44 :	13.07:	22.16:	0.00:	0.00:
3:	1:	0.22 :	12.67:	22.56:	0.00:	0.00:
4:	1:	0.06 :	12.03:	23.19:	0.00:	0.00:
5:	1:	0.00 :	11.08:	24.15:	0.00:	0.00:
6:	1:	0.00 :	9.80:	25.42:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld pre S/B
MODEL: TC08

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.025009	7.130801
400	15		0.025018	7.132059
600	15		0.025026	7.133318
800	15		0.025035	7.134579
1000	15		0.025044	7.135841
1200	15		0.025053	7.137104
1400	15		0.025062	7.138369
1600	15		0.025071	7.139635
1800	15		0.025080	7.140903
2000	15		0.025088	7.142171
2200	15		0.025097	7.143441
2400	15		0.025106	7.144713
2600	15		0.025115	7.145985
2800	15		0.025124	7.147259
3000	15		0.025133	7.148535
3200	15		0.025142	7.149811
3400	15		0.025151	7.151089
3600	15		0.025160	7.152369
3800	15		0.025169	7.153649
4000	15		0.025178	7.154931
4200	15		0.025187	7.156215
4400	15		0.025196	7.157499
4600	15		0.025205	7.158785
4800	15		0.025214	7.160073
5000	15		0.025223	7.161361
5200	15		0.025232	7.162651
5400	15		0.025241	7.163942
5600	15		0.025250	7.165235
5800	15		0.025259	7.166529

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

6000	15	0.025269	7.167824
6200	15	0.025278	7.169121
6400	15	0.025287	7.170418
6600	15	0.025296	7.171718
6800	15	0.025305	7.173018
7000	15	0.025314	7.174320
7200	15	0.025323	7.175623
7400	15	0.025333	7.176927
7600	15	0.025342	7.178233
7800	15	0.025351	7.179540
8000	15	0.025360	7.180848
8200	15	0.025369	7.182158
8400	15	0.025379	7.183469
8600	15	0.025388	7.184781
8800	15	0.025397	7.186094
9000	15	0.025406	7.187409
9200	15	0.025416	7.188725
9400	15	0.025425	7.190043
9600	15	0.025434	7.191361
9800	15	0.025444	7.192681
10000	15	0.025453	7.194003

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld pre S/B
MODEL: TC08

ANALYSIS RESULTS (contd)

Schedl	Block Step	Final Flaw Size c	K max c-tip
10200	15	0.025462	7.195325
10400	15	0.025472	7.196649
10600	15	0.025481	7.197974
10800	15	0.025490	7.199301
11000	15	0.025500	7.200629
11200	15	0.025509	7.201958
11400	15	0.025519	7.203288
11600	15	0.025528	7.204620
11800	15	0.025537	7.205953
12000	15	0.025547	7.207287
12200	15	0.025556	7.208623
12400	15	0.025566	7.209960
12600	15	0.025575	7.211298
12800	15	0.025585	7.212637
13000	15	0.025594	7.213978
13200	15	0.025604	7.215320
13400	15	0.025613	7.216663
13600	15	0.025623	7.218008
13800	15	0.025632	7.219354
14000	15	0.025642	7.220701
14200	15	0.025651	7.222049
14400	15	0.025661	7.223399
14600	15	0.025670	7.224750
14800	15	0.025680	7.226102
15000	15	0.025690	7.227456
15200	15	0.025699	7.228811
15400	15	0.025709	7.230167
15600	15	0.025718	7.231524
15800	15	0.025728	7.232883
16000	15	0.025738	7.234243
16200	15	0.025747	7.235604
16400	15	0.025757	7.236967
16600	15	0.025767	7.238330
16800	15	0.025776	7.239696
17000	15	0.025786	7.241062
17200	15	0.025796	7.242430
17400	15	0.025806	7.243799
17600	15	0.025815	7.245169
17800	15	0.025825	7.246540

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

18000	15	0.025835	7.247913
18200	15	0.025845	7.249287
18400	15	0.025854	7.250662
18600	15	0.025864	7.252039
18800	15	0.025874	7.253417
19000	15	0.025884	7.254796
19200	15	0.025894	7.256176
19400	15	0.025903	7.257558
19600	15	0.025913	7.258941
19800	15	0.025923	7.260325
20000	15	0.025933	7.261711

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld pre S/B
MODEL: TC08

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
20200	15		0.025943	7.263098
20400	15		0.025953	7.264486
20600	15		0.025963	7.265875
20800	15		0.025973	7.267293
21000	15		0.025983	7.268722

FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No. 0.00 of Load Step No. 6
Step description:
of Block No. 15 of Schedule No. 21000
Crack Size c = 0.259830E-01

FATIGUE CRACK GROWTH ANALYSIS

DATE: 09/10/98 TIME: 13:48:08
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld post S/B

GEOMETRY

MODEL: TC08-Through crack in cyl. in circumferential directio

Mean Radius of cylinder, R = 0.7975
Thickness of cylinder, t = 0.2050
Poisson s Ratio = 0.3300

FLAW SIZE:

c (init.) = 0.2500E-01

MATERIAL

MATL 1:
1 4130N

Material Properties:

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

```
:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  95.0:  75.0: 190.0: 135.0: 0.75: 0.50:  0.205: 202.3:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.170E-08:2.700:0.25:0.25:  6.00:  0.70: 2.50: 0.30:
 THROUGH CRACK CASE 8, PSE-EM1 Crack in weld post S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    2.7600
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    2.7600
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    2.7600
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    2.7600
Scale Factor for Stress S1:   0.00000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    2.7600
Scale Factor for Stress S1:   0.00000

Total No. of Blocks in Schedule =     15

   Block Number and Case Correspondences
 Block Number                   Block Case No.
From    -    To
    1   -     1                         1
    2   -     2                         2
    3   -     3                         5
    4   -     4                         1
    5   -     5                         3
    6   -     6                         5
    7   -     7                         1
    8   -     8                         3
    9   -     9                         5
   10   -    10                         1
   11   -    11                         3
   12   -    12                         5
   13   -    13                         1
   14   -    14                         4
   15   -    15                         5

BLOCK CASE NO.  1
 S   : M:  NUMBER     :        S0          :         S1          :
 T   : A:    OF       :                    :                     :
 E   : T:  FATIGUE    :                    :                     :
```

P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	1.90	1.91:	2.51:	-0.30:	0.30:
2:	1:	0.09	1.81:	2.61:	-0.40:	0.40:
3:	1:	0.01	1.75:	2.67:	-0.46:	0.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

S	M:	NUMBER	S0		S1	
T	A:	OF				
E	T:	FATIGUE				
P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	9.57	1.91:	2.51:	-0.30:	0.30:
2:	1:	1.14	1.71:	2.71:	-0.50:	0.50:
3:	1:	0.57	1.61:	2.81:	-0.60:	0.60:
4:	1:	0.11	1.41:	3.01:	-0.80:	0.80:
5:	1:	0.02	1.21:	3.21:	-1.00:	1.00:
6:	1:	0.01	1.01:	3.41:	-1.20:	1.20:
7:	1:	0.00	0.81:	3.61:	-1.40:	1.40:
8:	1:	0.00	0.61:	3.81:	-1.60:	1.60:
9:	1:	0.00	0.41:	4.01:	-1.80:	1.80:
10:	1:	0.00	0.21:	4.21:	-2.00:	2.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

S	M:	NUMBER	S0		S1	
T	A:	OF				
E	T:	FATIGUE				
P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	19.14	1.91:	2.51:	-0.30:	0.30:
2:	1:	2.29	1.71:	2.71:	-0.50:	0.50:
3:	1:	1.14	1.61:	2.81:	-0.60:	0.60:
4:	1:	0.23	1.41:	3.01:	-0.80:	0.80:
5:	1:	0.04	1.21:	3.21:	-1.00:	1.00:
6:	1:	0.01	1.01:	3.41:	-1.20:	1.20:
7:	1:	0.00	0.81:	3.61:	-1.40:	1.40:
8:	1:	0.00	0.61:	3.81:	-1.60:	1.60:
9:	1:	0.00	0.41:	4.01:	-1.80:	1.80:
10:	1:	0.00	0.21:	4.21:	-2.00:	2.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

S	M:	NUMBER	S0		S1	
T	A:	OF				
E	T:	FATIGUE				
P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	38.29	1.91:	2.51:	-0.30:	0.30:
2:	1:	4.57	1.71:	2.71:	-0.50:	0.50:
3:	1:	2.29	1.61:	2.81:	-0.60:	0.60:
4:	1:	0.46	1.41:	3.01:	-0.80:	0.80:
5:	1:	0.08	1.21:	3.21:	-1.00:	1.00:
6:	1:	0.02	1.01:	3.41:	-1.20:	1.20:
7:	1:	0.01	0.81:	3.61:	-1.40:	1.40:
8:	1:	0.00	0.61:	3.81:	-1.60:	1.60:
9:	1:	0.00	0.41:	4.01:	-1.80:	1.80:
10:	1:	0.00	0.21:	4.21:	-2.00:	2.00:

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.66	2.76	-0.55	0.55
2	1	0.44	1.64	2.78	-0.57	0.57
3	1	0.22	1.59	2.83	-0.62	0.62
4	1	0.06	1.51	2.91	-0.70	0.70
5	1	0.00	1.39	3.03	-0.82	0.82
6	1	0.00	1.23	3.19	-0.98	0.98

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld post S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	1.90	5.27	6.93	0.00	0.00
2	1	0.09	5.00	7.20	0.00	0.00
3	1	0.01	4.83	7.37	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld post S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	5.27	6.93	0.00	0.00
2	1	1.14	4.72	7.48	0.00	0.00
3	1	0.57	4.44	7.76	0.00	0.00
4	1	0.11	3.89	8.31	0.00	0.00
5	1	0.02	3.34	8.86	0.00	0.00
6	1	0.01	2.79	9.41	0.00	0.00
7	1	0.00	2.24	9.96	0.00	0.00
8	1	0.00	1.68	10.52	0.00	0.00
9	1	0.00	1.13	11.07	0.00	0.00
10	1	0.00	0.58	11.62	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld post S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	5.27	6.93	0.00	0.00
2	1	2.29	4.72	7.48	0.00	0.00
3	1	1.14	4.44	7.76	0.00	0.00
4	1	0.23	3.89	8.31	0.00	0.00
5	1	0.04	3.34	8.86	0.00	0.00
6	1	0.01	2.79	9.41	0.00	0.00
7	1	0.00	2.24	9.96	0.00	0.00
8	1	0.00	1.68	10.52	0.00	0.00
9	1	0.00	1.13	11.07	0.00	0.00
10	1	0.00	0.58	11.62	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld post S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	5.27	6.93	0.00	0.00
2	1	4.57	4.72	7.48	0.00	0.00
3	1	2.29	4.44	7.76	0.00	0.00
4	1	0.46	3.89	8.31	0.00	0.00
5	1	0.08	3.34	8.86	0.00	0.00
6	1	0.02	2.79	9.41	0.00	0.00
7	1	0.01	2.24	9.96	0.00	0.00
8	1	0.00	1.68	10.52	0.00	0.00
9	1	0.00	1.13	11.07	0.00	0.00
10	1	0.00	0.58	11.62	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld post S/B
MODEL: TC08

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.28	4.58	7.62	0.00	0.00
2	1	0.44	4.53	7.67	0.00	0.00
3	1	0.22	4.39	7.81	0.00	0.00
4	1	0.06	4.17	8.03	0.00	0.00
5	1	0.00	3.84	8.36	0.00	0.00
6	1	0.00	3.39	8.80	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 8, PSE-EM1 Crack in weld post S/B
MODEL: TC08

ANALYSIS RESULTS:

C-14 PSE EM1 Upper Engine Mount at Firewall (Continued)

```
-----------------

FINAL RESULTS:
All Stress Intensities are below the Fatigue Threshold.
NO growth in Schedule No.       1
Crack Size     c =  0.250000E-01
```

C-15 PSE N1 Upper Longeron at Firewall

FATIGUE CRACK GROWTH ANALYSIS

DATE: 09/11/98 TIME: 11:10:20

(computed: NASA/FLAGRO Version 2.03, March 1995.)

U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

THROUGH CRACK CASE 3, PSE-N1 hole crack in cap

GEOMETRY

MODEL: TC03-Through crack from hole in plate.

```
Plate Thickness, t =    0.0900
  "   Width, W     =    2.2500
Hole Diameter, D   =    0.1600
Hole-Center-to-Edge Dist., B =    1.1250
```

FLAW SIZE:

c (init.) = 0.5000E-01

MATERIAL

MATL 1: 2024-T3511
Extr; L-T; LA & HHA

Material Properties:

Matl: No.	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	77.0	55.0	35.0	25.0	1.00	1.00	0.090	49.3	

Matl: No.	C	n	p	q	DKo	Rcl	Alpha	Smax/SIGo
	Crack Growth Eqn Constants							
1	0.200E-07	2.700	0.50	1.00	2.90	0.70	1.50	0.30

THROUGH CRACK CASE 3, PSE-N1 hole crack in cap
MODEL: TC03

FATIGUE SCHEDULE BLOCK INPUT TABLE

STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

Scale Factor for Stress S0: 1.6900
Scale Factor for Stress S3: 21.560

Stress Scaling Factors for Block Case: 2

Scale Factor for Stress S0: 1.6900
Scale Factor for Stress S3: 21.560

C-15 PSE N1 Upper Longeron at Firewall (Continued)

```
Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:    1.6900
Scale Factor for Stress S3:    21.560

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:    1.6900
Scale Factor for Stress S3:    21.560

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:    1.6900
Scale Factor for Stress S3:    21.560

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From    -    To
    1   -      1                        1
    2   -      2                        2
    3   -      3                        5
    4   -      4                        1
    5   -      5                        3
    6   -      6                        5
    7   -      7                        1
    8   -      8                        3
    9   -      9                        5
   10   -     10                        1
   11   -     11                        3
   12   -     12                        5
   13   -     13                        1
   14   -     14                        4
   15   -     15                        5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :        S0          :        S3          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :                    :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.90 :   1.80:     2.40:    1.80:     2.40:
   2: 1:        0.09 :   1.70:     2.50:    1.70:     2.50:
   3: 1:        0.01 :   1.64:     2.56:    1.64:     2.56:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                         -------

BLOCK CASE NO.  2
 S   : M:  NUMBER      :        S0          :        S3          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :                    :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        9.57 :   1.80:     2.40:    1.80:     2.40:
   2: 1:        1.14 :   1.60:     2.60:    1.60:     2.60:
   3: 1:        0.57 :   1.50:     2.70:    1.50:     2.70:
   4: 1:        0.11 :   1.30:     2.90:    1.30:     2.90:
   5: 1:        0.02 :   1.10:     3.10:    1.10:     3.10:
   6: 1:        0.01 :   0.90:     3.30:    0.90:     3.30:
   7: 1:        0.00 :   0.70:     3.50:    0.70:     3.50:
   8: 1:        0.00 :   0.50:     3.70:    0.50:     3.70:
   9: 1:        0.00 :   0.30:     3.90:    0.30:     3.90:
  10: 1:        0.00 :   0.10:     4.10:    0.10:     4.10:

Environmental Crack Growth Check for Sustained Stresses
```

C-15 PSE N1 Upper Longeron at Firewall (Continued)

(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	19.14	1.80:	2.40:	1.80:	2.40:
2:	1:	2.29	1.60:	2.60:	1.60:	2.60:
3:	1:	1.14	1.50:	2.70:	1.50:	2.70:
4:	1:	0.23	1.30:	2.90:	1.30:	2.90:
5:	1:	0.04	1.10:	3.10:	1.10:	3.10:
6:	1:	0.01	0.90:	3.30:	0.90:	3.30:
7:	1:	0.00	0.70:	3.50:	0.70:	3.50:
8:	1:	0.00	0.50:	3.70:	0.50:	3.70:
9:	1:	0.00	0.30:	3.90:	0.30:	3.90:
10:	1:	0.00	0.10:	4.10:	0.10:	4.10:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	38.29	1.80:	2.40:	1.80:	2.40:
2:	1:	4.57	1.60:	2.60:	1.60:	2.60:
3:	1:	2.29	1.50:	2.70:	1.50:	2.70:
4:	1:	0.46	1.30:	2.90:	1.30:	2.90:
5:	1:	0.08	1.10:	3.10:	1.10:	3.10:
6:	1:	0.02	0.90:	3.30:	0.90:	3.30:
7:	1:	0.01	0.70:	3.50:	0.70:	3.50:
8:	1:	0.00	0.50:	3.70:	0.50:	3.70:
9:	1:	0.00	0.30:	3.90:	0.30:	3.90:
10:	1:	0.00	0.10:	4.10:	0.10:	4.10:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	0.28	1.55:	2.65:	1.55:	2.65:
2:	1:	0.44	1.53:	2.67:	1.53:	2.67:
3:	1:	0.22	1.48:	2.72:	1.48:	2.72:
4:	1:	0.06	1.40:	2.80:	1.40:	2.80:
5:	1:	0.00	1.28:	2.92:	1.28:	2.92:
6:	1:	0.00	1.12:	3.08:	1.12:	3.08:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-N1 hole crack in cap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF	S0	S3
S	M:	NUMBER		
T	A:	OF		

C-15 PSE N1 Upper Longeron at Firewall (Continued)

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	3.04	4.06	38.81	51.74
2	1	0.09	2.87	4.22	36.65	53.90
3	1	0.01	2.77	4.33	35.36	55.19

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-N1 hole crack in cap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	3.04	4.06	38.81	51.74
2	1	1.14	2.70	4.39	34.50	56.06
3	1	0.57	2.54	4.56	32.34	58.21
4	1	0.11	2.20	4.90	28.03	62.52
5	1	0.02	1.86	5.24	23.72	66.84
6	1	0.01	1.52	5.58	19.40	71.15
7	1	0.00	1.18	5.92	15.09	75.46
8	1	0.00	0.84	6.25	10.78	79.77
9	1	0.00	0.51	6.59	6.47	84.08
10	1	0.00	0.17	6.93	2.16	88.40

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-N1 hole crack in cap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	3.04	4.06	38.81	51.74
2	1	2.29	2.70	4.39	34.50	56.06
3	1	1.14	2.54	4.56	32.34	58.21
4	1	0.23	2.20	4.90	28.03	62.52
5	1	0.04	1.86	5.24	23.72	66.84
6	1	0.01	1.52	5.58	19.40	71.15
7	1	0.00	1.18	5.92	15.09	75.46
8	1	0.00	0.84	6.25	10.78	79.77
9	1	0.00	0.51	6.59	6.47	84.08
10	1	0.00	0.17	6.93	2.16	88.40

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-N1 hole crack in cap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi)	S3 (ksi)

C-15 PSE N1 Upper Longeron at Firewall (Continued)

P	L	CYCLES	(t1)	(t2)	(t1)	(t2)
1	1	38.29	3.04	4.06	38.81	51.74
2	1	4.57	2.70	4.39	34.50	56.06
3	1	2.29	2.54	4.56	32.34	58.21
4	1	0.46	2.20	4.90	28.03	62.52
5	1	0.08	1.86	5.24	23.72	66.84
6	1	0.02	1.52	5.58	19.40	71.15
7	1	0.01	1.18	5.92	15.09	75.46
8	1	0.00	0.84	6.25	10.78	79.77
9	1	0.00	0.51	6.59	6.47	84.08
10	1	0.00	0.17	6.93	2.16	88.40

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-N1 hole crack in cap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	2.62	4.48	33.42	57.13
2	1	0.44	2.59	4.51	32.99	57.57
3	1	0.22	2.50	4.60	31.91	58.64
4	1	0.06	2.37	4.73	30.18	60.37
5	1	0.00	2.16	4.93	27.60	62.96
6	1	0.00	1.89	5.21	24.15	66.40

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-N1 hole crack in cap
MODEL: TC03

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.058654	12.411067
400	15		0.066592	12.116725
600	15		0.073967	11.870115
800	15		0.080888	11.660828
1000	15		0.087438	11.480939
1200	15		0.093678	11.324545
1400	15		0.099655	11.187227
1600	15		0.105407	11.065636
1800	15		0.110963	10.957187
2000	15		0.116348	10.859859
2200	15		0.121582	10.772047
2400	15		0.126683	10.692457
2600	15		0.131663	10.620034
2800	15		0.136536	10.553910
3000	15		0.141312	10.493361
3200	15		0.146000	10.437778
3400	15		0.150608	10.386647
3600	15		0.155144	10.339525
3800	15		0.159613	10.296035
4000	15		0.164022	10.255850
4200	15		0.168375	10.218682
4400	15		0.172677	10.184284

4600	15	0.176931	10.152435
4800	15	0.181143	10.122940
5000	15	0.185315	10.095629
5200	15	0.189450	10.070347
5400	15	0.193552	10.046958
5600	15	0.197622	10.025338
5800	15	0.201664	10.005376
6000	15	0.205680	9.986974
6200	15	0.209671	9.970041
6400	15	0.213641	9.954495
6600	15	0.217590	9.940262
6800	15	0.221521	9.927274
7000	15	0.225435	9.915469
7200	15	0.229335	9.904790
7400	15	0.233220	9.895188
7600	15	0.237093	9.886612
7800	15	0.240956	9.879022
8000	15	0.244808	9.872376
8200	15	0.248653	9.866638
8400	15	0.252490	9.861773
8600	15	0.256322	9.857753
8800	15	0.260148	9.854546
9000	15	0.263970	9.852128
9200	15	0.267790	9.850473
9400	15	0.271608	9.849561
9600	15	0.275425	9.849369
9800	15	0.279242	9.849879
10000	15	0.283060	9.851074

THROUGH CRACK CASE 3, PSE-N1 hole crack in cap
MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
10200	15		0.286879	9.852938
10400	15		0.290702	9.855457
10600	15		0.294528	9.858616
10800	15		0.298358	9.862404
11000	15		0.302194	9.866810
11200	15		0.306035	9.871824
11400	15		0.309884	9.877437
11600	15		0.313740	9.883642
11800	15		0.317604	9.890430
12000	15		0.321478	9.897796
12200	15		0.325361	9.905736
12400	15		0.329256	9.914243
12600	15		0.333161	9.923315
12800	15		0.337079	9.932949
13000	15		0.341010	9.943142
13200	15		0.344955	9.953894
13400	15		0.348915	9.965203
13600	15		0.352890	9.977070
13800	15		0.356881	9.989496
14000	15		0.360889	10.002481
14200	15		0.364914	10.016029
14400	15		0.368959	10.030142
14600	15		0.373023	10.044825
14800	15		0.377107	10.060080
15000	15		0.381212	10.075914
15200	15		0.385339	10.092333
15400	15		0.389489	10.109343
15600	15		0.393663	10.126952
15800	15		0.397861	10.145167
16000	15		0.402085	10.164000
16200	15		0.406336	10.183458
16400	15		0.410614	10.203554

C-15 PSE N1 Upper Longeron at Firewall (Continued)

16600	15	0.414921	10.224299
16800	15	0.419258	10.245706
17000	15	0.423625	10.267790
17200	15	0.428024	10.290565
17400	15	0.432457	10.314048
17600	15	0.436924	10.338256
17800	15	0.441426	10.363208
18000	15	0.445965	10.388924
18200	15	0.450542	10.415426
18400	15	0.455158	10.442738
18600	15	0.459816	10.470883
18800	15	0.464516	10.499889
19000	15	0.469260	10.529785
19200	15	0.474049	10.560601
19400	15	0.478886	10.592370
19600	15	0.483772	10.625128
19800	15	0.488709	10.658913
20000	15	0.493699	10.693766

THROUGH CRACK CASE 3, PSE-N1 hole crack in cap
MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block Step	Final Flaw Size c	K max c-tip
20200	15	0.498745	10.729731
20400	15	0.503847	10.766855
20600	15	0.509009	10.805190
20800	15	0.514233	10.844791
21000	15	0.519522	10.885718
21200	15	0.524878	10.928036
21400	15	0.530305	10.971814
21600	15	0.535804	11.017130
21800	15	0.541380	11.064065
22000	15	0.547037	11.112710
22200	15	0.552777	11.163164
22400	15	0.558605	11.215535
22600	15	0.564525	11.269941
22800	15	0.570543	11.326513
23000	15	0.576662	11.385393
23200	15	0.582888	11.446742
23400	15	0.589228	11.510735
23600	15	0.595687	11.577568
23800	15	0.602274	11.647460
24000	15	0.608994	11.720657
24200	15	0.615857	11.797434
24400	15	0.622872	11.878103
24600	15	0.630049	11.963019
24800	15	0.637401	12.052586
25000	15	0.644938	12.147269
25200	15	0.652677	12.247604
25400	15	0.660633	12.354215
25600	15	0.668824	12.467832
25800	15	0.677272	12.589318
26000	15	0.686000	12.719702
26200	15	0.695038	12.860221
26400	15	0.704418	13.012383
26600	15	0.714180	13.178048
26800	15	0.724370	13.359543
27000	15	0.735047	13.559834
27200	15	0.746281	13.782770
27400	15	0.758162	14.033473
27600	15	0.770806	14.318949
27800	15	0.784368	14.649117
28000	15	0.799058	15.038642
28200	15	0.815183	15.510456
28400	15	0.833211	16.103210

```
  28600        15                 0.853926               16.889414
  28800        15                 0.878830               18.029788

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.   10
Step description:
of Block No.      11  of Schedule No.   28868
Crack Size      c =  0.888713
  29000        15                 0.911603               20.007811

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No.   10
Step description:
of Block No.      11  of Schedule No.   29057
Crack Size      c =  0.923644
```

C-16 PSE N2 Upper Nacelle Longeron at Wing Rib Attach Angle

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    -----------------------------
                  DATE: 09/11/98    TIME: 12:32:37
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 5, PSE-N2 hole crack in .090 cap

GEOMETRY
--------
MODEL: TC05-Through crack from hole in row of holes.

Plate Thickness, t =    0.0900
Hole Dia., D       =    0.1900
Hole-to-Hole Dist., H      =    1.0000
Dia./Edge-Dist. Ratio, D/B =    0.3750
(D/B = 0 means B is very large)

FLAW SIZE:

c   (init.) =  0.5000E-01



MATERIAL
--------

MATL 1: 2024-T3511
        Extr; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  77.0:  55.0:  35.0:  25.0: 1.00: 1.00:  0.090:  49.3:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200E-07:2.700:0.50:1.00:  2.90:  0.70: 1.50: 0.30:
 THROUGH CRACK CASE 5, PSE-N2 hole crack in .090 cap
MODEL: TC05

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    4.0900
Scale Factor for Stress S4:   0.00000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    4.0900
Scale Factor for Stress S4:   0.00000
```

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 0.00000
Scale Factor for Stress S3: 4.0900
Scale Factor for Stress S4: 0.00000

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 0.00000
Scale Factor for Stress S3: 4.0900
Scale Factor for Stress S4: 0.00000

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 0.00000
Scale Factor for Stress S3: 1.8100
Scale Factor for Stress S4: 0.00000

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	1.90	-0.30:	0.30:	-2.73:	-2.13:
2:	1:	0.09	-0.40:	0.40:	-2.83:	-2.03:
3:	1:	0.01	-0.46:	0.46:	-2.89:	-1.97:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1:	1:	1.90	-0.30:	0.30:	0.00:	0.00:
2:	1:	0.09	-0.40:	0.40:	0.00:	0.00:
3:	1:	0.01	-0.46:	0.46:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1:	1:	9.57	-0.30:	0.30:	-2.73:	-2.13:
2:	1:	1.14	-0.50:	0.50:	-2.93:	-1.93:

C-16 PSE N2 Upper Nacelle Longeron at Wing Rib Attach Angle (Continued)

```
  3: 1:         0.57 :   -0.60:     0.60:    -3.03:    -1.83:
  4: 1:         0.11 :   -0.80:     0.80:    -3.23:    -1.63:
  5: 1:         0.02 :   -1.00:     1.00:    -3.43:    -1.43:
  6: 1:         0.01 :   -1.20:     1.20:    -3.63:    -1.23:
  7: 1:         0.00 :   -1.40:     1.40:    -3.83:    -1.03:
  8: 1:         0.00 :   -1.60:     1.60:    -4.03:    -0.83:
  9: 1:         0.00 :   -1.80:     1.80:    -4.23:    -0.63:
 10: 1:         0.00 :   -2.00:     2.00:    -4.43:    -0.43:
 S  : M:  NUMBER     :       S4          :       S           :
 T  : A:    OF       :                   :                   :
 E  : T:  FATIGUE    :                   :                   :
 P  : L:  CYCLES     :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         9.57 :    0.70:     1.30:     0.00:     0.00:
  2: 1:         1.14 :    0.50:     1.50:     0.00:     0.00:
  3: 1:         0.57 :    0.40:     1.60:     0.00:     0.00:
  4: 1:         0.11 :    0.20:     1.80:     0.00:     0.00:
  5: 1:         0.02 :    0.00:     2.00:     0.00:     0.00:
  6: 1:         0.01 :   -0.20:     2.20:     0.00:     0.00:
  7: 1:         0.00 :   -0.40:     2.40:     0.00:     0.00:
  8: 1:         0.00 :   -0.60:     2.60:     0.00:     0.00:
  9: 1:         0.00 :   -0.80:     2.80:     0.00:     0.00:
 10: 1:         0.00 :   -1.00:     3.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S  : M:  NUMBER     :       S0          :       S3          :
 T  : A:    OF       :                   :                   :
 E  : T:  FATIGUE    :                   :                   :
 P  : L:  CYCLES     :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        19.14 :   -0.30:     0.30:    -2.73:    -2.13:
  2: 1:         2.29 :   -0.50:     0.50:    -2.93:    -1.93:
  3: 1:         1.14 :   -0.60:     0.60:    -3.03:    -1.83:
  4: 1:         0.23 :   -0.80:     0.80:    -3.23:    -1.63:
  5: 1:         0.04 :   -1.00:     1.00:    -3.43:    -1.43:
  6: 1:         0.01 :   -1.20:     1.20:    -3.63:    -1.23:
  7: 1:         0.00 :   -1.40:     1.40:    -3.83:    -1.03:
  8: 1:         0.00 :   -1.60:     1.60:    -4.03:    -0.83:
  9: 1:         0.00 :   -1.80:     1.80:    -4.23:    -0.63:
 10: 1:         0.00 :   -2.00:     2.00:    -4.43:    -0.43:
 S  : M:  NUMBER     :       S4          :       S           :
 T  : A:    OF       :                   :                   :
 E  : T:  FATIGUE    :                   :                   :
 P  : L:  CYCLES     :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        19.14 :    0.70:     1.30:     0.00:     0.00:
  2: 1:         2.29 :    0.50:     1.50:     0.00:     0.00:
  3: 1:         1.14 :    0.40:     1.60:     0.00:     0.00:
  4: 1:         0.23 :    0.20:     1.80:     0.00:     0.00:
  5: 1:         0.04 :    0.00:     2.00:     0.00:     0.00:
  6: 1:         0.01 :   -0.20:     2.20:     0.00:     0.00:
  7: 1:         0.00 :   -0.40:     2.40:     0.00:     0.00:
  8: 1:         0.00 :   -0.60:     2.60:     0.00:     0.00:
  9: 1:         0.00 :   -0.80:     2.80:     0.00:     0.00:
 10: 1:         0.00 :   -1.00:     3.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
 S  : M:  NUMBER     :       S0          :       S3          :
 T  : A:    OF       :                   :                   :
 E  : T:  FATIGUE    :                   :                   :
 P  : L:  CYCLES     :    (t1) :  (t2)   :    (t1) :  (t2)   :
```

C-16 PSE N2 Upper Nacelle Longeron at Wing Rib Attach Angle (Continued)

```
----:--:-------------:---------:---------:---------:---------:
   1: 1:        38.29 :   -0.30:     0.30:    -2.73:    -2.13:
   2: 1:         4.57 :   -0.50:     0.50:    -2.93:    -1.93:
   3: 1:         2.29 :   -0.60:     0.60:    -3.03:    -1.83:
   4: 1:         0.46 :   -0.80:     0.80:    -3.23:    -1.63:
   5: 1:         0.08 :   -1.00:     1.00:    -3.43:    -1.43:
   6: 1:         0.02 :   -1.20:     1.20:    -3.63:    -1.23:
   7: 1:         0.01 :   -1.40:     1.40:    -3.83:    -1.03:
   8: 1:         0.00 :   -1.60:     1.60:    -4.03:    -0.83:
   9: 1:         0.00 :   -1.80:     1.80:    -4.23:    -0.63:
  10: 1:         0.00 :   -2.00:     2.00:    -4.43:    -0.43:
 S  : M:  NUMBER      :        S4         :        S          :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :                   :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        38.29 :   -0.30:     0.30:     0.00:     0.00:
   2: 1:         4.57 :   -0.50:     0.50:     0.00:     0.00:
   3: 1:         2.29 :   -0.60:     0.60:     0.00:     0.00:
   4: 1:         0.46 :   -0.80:     0.80:     0.00:     0.00:
   5: 1:         0.08 :   -1.00:     1.00:     0.00:     0.00:
   6: 1:         0.02 :   -1.20:     1.20:     0.00:     0.00:
   7: 1:         0.01 :   -1.40:     1.40:     0.00:     0.00:
   8: 1:         0.00 :   -1.60:     1.60:     0.00:     0.00:
   9: 1:         0.00 :   -1.80:     1.80:     0.00:     0.00:
  10: 1:         0.00 :   -2.00:     2.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  5
 S  : M:  NUMBER      :        S0         :        S3         :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :                   :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.28 :    1.00:     1.01:     1.00:     1.01:
   2: 1:         0.44 :   -1.84:     4.64:    -1.84:     4.64:
   3: 1:         0.22 :   -4.69:     8.28:    -4.69:     8.28:
   4: 1:         0.06 :   -7.53:    11.92:    -7.53:    11.92:
   5: 1:         0.00 :  -10.37:    15.56:   -10.37:    15.56:
   6: 1:         0.00 :  -13.22:    19.20:   -13.22:    19.20:
 S  : M:  NUMBER      :        S4         :        S          :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :                   :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         0.28 :    1.00:     1.01:     0.00:     0.00:
   2: 1:         0.44 :   -1.84:     4.64:     0.00:     0.00:
   3: 1:         0.22 :   -4.69:     8.28:     0.00:     0.00:
   4: 1:         0.06 :   -7.53:    11.92:     0.00:     0.00:
   5: 1:         0.00 :  -10.37:    15.56:     0.00:     0.00:
   6: 1:         0.00 :  -13.22:    19.20:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 THROUGH CRACK CASE 5, PSE-N2 hole crack in .090 cap
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
 S  : M:  NUMBER      :        S0         :        S3         :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :      (ksi)        :      (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
```

C-16 PSE N2 Upper Nacelle Longeron at Wing Rib Attach Angle (Continued)

1	1	1.90	0.00	0.00	-11.17	-8.71
2	1	0.09	0.00	0.00	-11.57	-8.30
3	1	0.01	0.00	0.00	-11.82	-8.06

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 5, PSE-N2 hole crack in .090 cap
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	0.00	0.00	-11.17	-8.71
2	1	1.14	0.00	0.00	-11.98	-7.89
3	1	0.57	0.00	0.00	-12.39	-7.48
4	1	0.11	0.00	0.00	-13.21	-6.67
5	1	0.02	0.00	0.00	-14.03	-5.85
6	1	0.01	0.00	0.00	-14.85	-5.03
7	1	0.00	0.00	0.00	-15.66	-4.21
8	1	0.00	0.00	0.00	-16.48	-3.39
9	1	0.00	0.00	0.00	-17.30	-2.58
10	1	0.00	0.00	0.00	-18.12	-1.76

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	0.00	0.00	0.00	0.00
2	1	1.14	0.00	0.00	0.00	0.00
3	1	0.57	0.00	0.00	0.00	0.00
4	1	0.11	0.00	0.00	0.00	0.00
5	1	0.02	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 5, PSE-N2 hole crack in .090 cap
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	0.00	0.00	-11.17	-8.71
2	1	2.29	0.00	0.00	-11.98	-7.89
3	1	1.14	0.00	0.00	-12.39	-7.48

4	1	0.23	0.00	0.00	-13.21	-6.67
5	1	0.04	0.00	0.00	-14.03	-5.85
6	1	0.01	0.00	0.00	-14.85	-5.03
7	1	0.00	0.00	0.00	-15.66	-4.21
8	1	0.00	0.00	0.00	-16.48	-3.39
9	1	0.00	0.00	0.00	-17.30	-2.58
10	1	0.00	0.00	0.00	-18.12	-1.76

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00
2	1	2.29	0.00	0.00	0.00	0.00
3	1	1.14	0.00	0.00	0.00	0.00
4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.04	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 5, PSE-N2 hole crack in .090 cap
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	0.00	0.00	-11.17	-8.71
2	1	4.57	0.00	0.00	-11.98	-7.89
3	1	2.29	0.00	0.00	-12.39	-7.48
4	1	0.46	0.00	0.00	-13.21	-6.67
5	1	0.08	0.00	0.00	-14.03	-5.85
6	1	0.02	0.00	0.00	-14.85	-5.03
7	1	0.01	0.00	0.00	-15.66	-4.21
8	1	0.00	0.00	0.00	-16.48	-3.39
9	1	0.00	0.00	0.00	-17.30	-2.58
10	1	0.00	0.00	0.00	-18.12	-1.76

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	38.29	0.00	0.00	0.00	0.00
2	1	4.57	0.00	0.00	0.00	0.00
3	1	2.29	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.08	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 5, PSE-N2 hole crack in .090 cap
MODEL: TC05

C-16 PSE N2 Upper Nacelle Longeron at Wing Rib Attach Angle (Continued)

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	0.28	0.00	0.00	1.81	1.83
2	1	0.44	0.00	0.00	-3.33	8.40
3	1	0.22	0.00	0.00	-8.49	14.99
4	1	0.06	0.00	0.00	-13.63	21.58
5	1	0.00	0.00	0.00	-18.77	28.16
6	1	0.00	0.00	0.00	-23.93	34.75

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	0.00	0.00	0.00	0.00
2	1	0.44	0.00	0.00	0.00	0.00
3	1	0.22	0.00	0.00	0.00	0.00
4	1	0.06	0.00	0.00	0.00	0.00
5	1	0.00	0.00	0.00	0.00	0.00
6	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 5, PSE-N2 hole crack in .090 cap
MODEL: TC05

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.050015	6.651662
400	15		0.050030	6.651563
600	15		0.050044	6.651463
800	15		0.050059	6.651363
1000	15		0.050074	6.651264
1200	15		0.050089	6.651164
1400	15		0.050103	6.651064
1600	15		0.050118	6.650963
1800	15		0.050133	6.650863
2000	15		0.050148	6.650762
2200	15		0.050162	6.650662
2400	15		0.050177	6.650561
2600	15		0.050192	6.650460
2800	15		0.050207	6.650359
3000	15		0.050221	6.650258
3200	15		0.050236	6.650157
3400	15		0.050251	6.650055
3600	15		0.050266	6.649954
3800	15		0.050280	6.649852
4000	15		0.050295	6.649750
4200	15		0.050310	6.649648
4400	15		0.050325	6.649546
4600	15		0.050339	6.649444
4800	15		0.050354	6.649341
5000	15		0.050369	6.649239
5200	15		0.050383	6.649136
5400	15		0.050398	6.649033
5600	15		0.050413	6.648930
5800	15		0.050428	6.648827
6000	15		0.050442	6.648724

C-16 PSE N2 Upper Nacelle Longeron at Wing Rib Attach Angle (Continued)

6200	15	0.050457	6.648621
6400	15	0.050472	6.648517
6600	15	0.050486	6.648414
6800	15	0.050501	6.648310
7000	15	0.050516	6.648206
7200	15	0.050530	6.648102
7400	15	0.050545	6.647998
7600	15	0.050560	6.647894
7800	15	0.050574	6.647789
8000	15	0.050589	6.647685
8200	15	0.050604	6.647580
8400	15	0.050619	6.647476
8600	15	0.050633	6.647371
8800	15	0.050648	6.647266
9000	15	0.050663	6.647161
9200	15	0.050677	6.647055
9400	15	0.050692	6.646950
9600	15	0.050706	6.646844
9800	15	0.050721	6.646739
10000	15	0.050736	6.646633

THROUGH CRACK CASE 5, PSE-N2 hole crack in .090 cap
MODEL: TC05

ANALYSIS RESULTS (contd)

Schedl	Block Step	Final Flaw Size c	K max c-tip
10200	15	0.050750	6.646527
10400	15	0.050765	6.646421
10600	15	0.050780	6.646315
10800	15	0.050794	6.646209
11000	15	0.050809	6.646102
11200	15	0.050824	6.645996
11400	15	0.050838	6.645889
11600	15	0.050853	6.645782
11800	15	0.050868	6.645675
12000	15	0.050882	6.645568
12200	15	0.050897	6.645461
12400	15	0.050911	6.645354
12600	15	0.050926	6.645247
12800	15	0.050941	6.645139
13000	15	0.050955	6.645032
13200	15	0.050970	6.644924
13400	15	0.050985	6.644816
13600	15	0.050999	6.644708
13800	15	0.051014	6.644600
14000	15	0.051028	6.644492
14200	15	0.051043	6.644383
14400	15	0.051058	6.644275
14600	15	0.051072	6.644166
14800	15	0.051087	6.644058
15000	15	0.051101	6.643949
15200	15	0.051116	6.643840
15400	15	0.051130	6.643731
15600	15	0.051145	6.643622
15800	15	0.051160	6.643512
16000	15	0.051174	6.643403
16200	15	0.051189	6.643293
16400	15	0.051203	6.643184
16600	15	0.051218	6.643074
16800	15	0.051232	6.642964
17000	15	0.051247	6.642854
17200	15	0.051262	6.642744
17400	15	0.051276	6.642634
17600	15	0.051291	6.642523
17800	15	0.051305	6.642413
18000	15	0.051320	6.642302

18200	15	0.051334	6.642192
18400	15	0.051349	6.642081
18600	15	0.051363	6.641970
18800	15	0.051378	6.641859
19000	15	0.051393	6.641748
19200	15	0.051407	6.641637
19400	15	0.051422	6.641525
19600	15	0.051436	6.641414
19800	15	0.051451	6.641302
20000	15	0.051465	6.641190

THROUGH CRACK CASE 5, PSE-N2 hole crack in .090 cap
MODEL: TC05

ANALYSIS RESULTS (contd)

Schedl	Block Step	Final Flaw Size c	K max c-tip
20200	15	0.051480	6.641079
20400	15	0.051494	6.640967
20600	15	0.051509	6.640855
20800	15	0.051523	6.640742
21000	15	0.051538	6.640630

FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No. 0.00 of Load Step No. 6
Step description:
of Block No. 15 of Schedule No. 21000
Crack Size c = 0.515378E-01

C-17 PSE N3 Upper Longeron at Wing Rib Attach Angle

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    -----------------------------
                  DATE: 09/09/98    TIME: 19:07:17
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC2, PSE-N3 Nacelle upper longeron rib attach angles       (

GEOMETRY
--------
MODEL: TC02-Single edge through crack.

Plate Thickness, t =    0.0630
  "   Width, W     =    5.2500

FLAW SIZE:

c   (init.) =  0.5000E-01




MATERIAL
--------

MATL 1: 2024-T351
        Plt & Sht; T-L; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  68.0:  52.0:  41.0:  29.0: 1.00: 1.00:  0.063:  57.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:----------:-----:----:----:------:------:-----:-----:
:  1 :0.922E-08:3.353:0.50:1.00:  2.60:  0.70: 1.50: 0.30:
 TC2, PSE-N3 Nacelle upper longeron rib attach angles       (
MODEL: TC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    6.4100
Scale Factor for Stress S2:   0.00000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:    6.4100
Scale Factor for Stress S2:   0.00000
```

C-17 PSE N3 Upper Longeron at Wing Rib Attach Angle (Continued)

```
Stress Scaling Factors for Block Case:  3

        Scale Factor for Stress S0:   0.00000
        Scale Factor for Stress S1:    6.4100
        Scale Factor for Stress S2:   0.00000

        Stress Scaling Factors for Block Case:  4

        Scale Factor for Stress S0:   0.00000
        Scale Factor for Stress S1:    6.4100
        Scale Factor for Stress S2:   0.00000

        Stress Scaling Factors for Block Case:  5

        Scale Factor for Stress S0:   0.00000
        Scale Factor for Stress S1:    2.8300
        Scale Factor for Stress S2:   0.00000

        Total No. of Blocks in Schedule =    15

           Block Number and Case Correspondences
         Block Number                  Block Case No.
        From   -   To
            1   -     1                         1
            2   -     2                         2
            3   -     3                         5
            4   -     4                         1
            5   -     5                         3
            6   -     6                         5
            7   -     7                         1
            8   -     8                         3
            9   -     9                         5
           10   -    10                         1
           11   -    11                         3
           12   -    12                         5
           13   -    13                         1
           14   -    14                         4
           15   -    15                         5

        BLOCK CASE NO.  1
         S  : M:  NUMBER      :         S0         :         S1         :
         T  : A:    OF        :                    :                    :
         E  : T:  FATIGUE     :                    :                    :
         P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
        ----:--:--------------:---------:---------:---------:---------:
           1: 1:         1.90 :   -0.30:     0.30:    -2.73:    -2.13:
           2: 1:         0.09 :   -0.40:     0.40:    -2.83:    -2.03:
           3: 1:         0.01 :   -0.46:     0.46:    -2.89:    -1.97:
         S  : M:  NUMBER      :         S2         :         S          :
         T  : A:    OF        :                    :                    :
         E  : T:  FATIGUE     :                    :                    :
         P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
        ----:--:--------------:---------:---------:---------:---------:
           1: 1:         1.90 :   -0.30:     0.30:     0.00:     0.00:
           2: 1:         0.09 :   -0.40:     0.40:     0.00:     0.00:
           3: 1:         0.01 :   -0.46:     0.46:     0.00:     0.00:

        Environmental Crack Growth Check for Sustained Stresses
        (Kmax less than KIscc): NOT SET
                                -------

        BLOCK CASE NO.  2
         S  : M:  NUMBER      :         S0         :         S1         :
         T  : A:    OF        :                    :                    :
         E  : T:  FATIGUE     :                    :                    :
         P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
        ----:--:--------------:---------:---------:---------:---------:
           1: 1:         9.57 :   -0.30:     0.30:    -2.73:    -2.13:
           2: 1:         1.14 :   -0.50:     0.50:    -2.93:    -1.93:
```

```
   3: 1:          0.57 :   -0.60:     0.60:   -3.03:    -1.83:
   4: 1:          0.11 :   -0.80:     0.80:   -3.23:    -1.63:
   5: 1:          0.02 :   -1.00:     1.00:   -3.43:    -1.43:
   6: 1:          0.01 :   -1.20:     1.20:   -3.63:    -1.23:
   7: 1:          0.00 :   -1.40:     1.40:   -3.83:    -1.03:
   8: 1:          0.00 :   -1.60:     1.60:   -4.03:    -0.83:
   9: 1:          0.00 :   -1.80:     1.80:   -4.23:    -0.63:
  10: 1:          0.00 :   -2.00:     2.00:   -4.43:    -0.43:
 S  : M:  NUMBER       :       S2         :       S          :
 T  : A:    OF         :                  :                  :
 E  : T:  FATIGUE      :                  :                  :
 P  : L:  CYCLES       :   (t1) :  (t2)   :   (t1) :  (t2)   :
----:--:---------------:---------:---------:---------:---------:
   1: 1:          9.57 :   -0.30:     0.30:    0.00:     0.00:
   2: 1:          1.14 :   -0.50:     0.50:    0.00:     0.00:
   3: 1:          0.57 :   -0.60:     0.60:    0.00:     0.00:
   4: 1:          0.11 :   -0.80:     0.80:    0.00:     0.00:
   5: 1:          0.02 :   -1.00:     1.00:    0.00:     0.00:
   6: 1:          0.01 :   -1.20:     1.20:    0.00:     0.00:
   7: 1:          0.00 :   -1.40:     1.40:    0.00:     0.00:
   8: 1:          0.00 :   -1.60:     1.60:    0.00:     0.00:
   9: 1:          0.00 :   -1.80:     1.80:    0.00:     0.00:
  10: 1:          0.00 :   -2.00:     2.00:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
 S  : M:  NUMBER       :       S0         :       S1         :
 T  : A:    OF         :                  :                  :
 E  : T:  FATIGUE      :                  :                  :
 P  : L:  CYCLES       :   (t1) :  (t2)   :   (t1) :  (t2)   :
----:--:---------------:---------:---------:---------:---------:
   1: 1:         19.14 :   -0.30:     0.30:   -2.73:    -2.13:
   2: 1:          2.29 :   -0.50:     0.50:   -2.93:    -1.93:
   3: 1:          1.14 :   -0.60:     0.60:   -3.03:    -1.83:
   4: 1:          0.23 :   -0.80:     0.80:   -3.23:    -1.63:
   5: 1:          0.04 :   -1.00:     1.00:   -3.43:    -1.43:
   6: 1:          0.01 :   -1.20:     1.20:   -3.63:    -1.23:
   7: 1:          0.00 :   -1.40:     1.40:   -3.83:    -1.03:
   8: 1:          0.00 :   -1.60:     1.60:   -4.03:    -0.83:
   9: 1:          0.00 :   -1.80:     1.80:   -4.23:    -0.63:
  10: 1:          0.00 :   -2.00:     2.00:   -4.43:    -0.43:
 S  : M:  NUMBER       :       S2         :       S          :
 T  : A:    OF         :                  :                  :
 E  : T:  FATIGUE      :                  :                  :
 P  : L:  CYCLES       :   (t1) :  (t2)   :   (t1) :  (t2)   :
----:--:---------------:---------:---------:---------:---------:
   1: 1:         19.14 :   -0.30:     0.30:    0.00:     0.00:
   2: 1:          2.29 :   -0.50:     0.50:    0.00:     0.00:
   3: 1:          1.14 :   -0.60:     0.60:    0.00:     0.00:
   4: 1:          0.23 :   -0.80:     0.80:    0.00:     0.00:
   5: 1:          0.04 :   -1.00:     1.00:    0.00:     0.00:
   6: 1:          0.01 :   -1.20:     1.20:    0.00:     0.00:
   7: 1:          0.00 :   -1.40:     1.40:    0.00:     0.00:
   8: 1:          0.00 :   -1.60:     1.60:    0.00:     0.00:
   9: 1:          0.00 :   -1.80:     1.80:    0.00:     0.00:
  10: 1:          0.00 :   -2.00:     2.00:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
 S  : M:  NUMBER       :       S0         :       S1         :
 T  : A:    OF         :                  :                  :
 E  : T:  FATIGUE      :                  :                  :
 P  : L:  CYCLES       :   (t1) :  (t2)   :   (t1) :  (t2)   :
```

C-17 PSE N3 Upper Longeron at Wing Rib Attach Angle (Continued)

1	1	38.29	-0.30	0.30	-2.73	-2.13
2	1	4.57	-0.50	0.50	-2.93	-1.93
3	1	2.29	-0.60	0.60	-3.03	-1.83
4	1	0.46	-0.80	0.80	-3.23	-1.63
5	1	0.08	-1.00	1.00	-3.43	-1.43
6	1	0.02	-1.20	1.20	-3.63	-1.23
7	1	0.01	-1.40	1.40	-3.83	-1.03
8	1	0.00	-1.60	1.60	-4.03	-0.83
9	1	0.00	-1.80	1.80	-4.23	-0.63
10	1	0.00	-2.00	2.00	-4.43	-0.43

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	38.29	-0.30	0.30	0.00	0.00
2	1	4.57	-0.50	0.50	0.00	0.00
3	1	2.29	-0.60	0.60	0.00	0.00
4	1	0.46	-0.80	0.80	0.00	0.00
5	1	0.08	-1.00	1.00	0.00	0.00
6	1	0.02	-1.20	1.20	0.00	0.00
7	1	0.01	-1.40	1.40	0.00	0.00
8	1	0.00	-1.60	1.60	0.00	0.00
9	1	0.00	-1.80	1.80	0.00	0.00
10	1	0.00	-2.00	2.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	1.00	1.01	1.00	1.01
2	1	0.44	-1.84	4.64	-1.84	4.64
3	1	0.22	-4.69	8.28	-4.69	8.28
4	1	0.06	-7.53	11.92	-7.53	11.92
5	1	0.00	-10.37	15.56	-10.37	15.56
6	1	0.00	-13.22	19.20	-13.22	19.20

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	0.28	1.00	1.01	0.00	0.00
2	1	0.44	-1.84	4.64	0.00	0.00
3	1	0.22	-4.69	8.28	0.00	0.00
4	1	0.06	-7.53	11.92	0.00	0.00
5	1	0.00	-10.37	15.56	0.00	0.00
6	1	0.00	-13.22	19.20	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-N3 Nacelle upper longeron rib attach angles (
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)

1	1	1.90	0.00	0.00	-17.50	-13.65
2	1	0.09	0.00	0.00	-18.14	-13.01
3	1	0.01	0.00	0.00	-18.52	-12.63

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-N3 Nacelle upper longeron rib attach angles (
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	0.00	0.00	-17.50	-13.65
2	1	1.14	0.00	0.00	-18.78	-12.37
3	1	0.57	0.00	0.00	-19.42	-11.73
4	1	0.11	0.00	0.00	-20.70	-10.45
5	1	0.02	0.00	0.00	-21.99	-9.17
6	1	0.01	0.00	0.00	-23.27	-7.88
7	1	0.00	0.00	0.00	-24.55	-6.60
8	1	0.00	0.00	0.00	-25.83	-5.32
9	1	0.00	0.00	0.00	-27.11	-4.04
10	1	0.00	0.00	0.00	-28.40	-2.76

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	0.00	0.00	0.00	0.00
2	1	1.14	0.00	0.00	0.00	0.00
3	1	0.57	0.00	0.00	0.00	0.00
4	1	0.11	0.00	0.00	0.00	0.00
5	1	0.02	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-N3 Nacelle upper longeron rib attach angles (
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	0.00	0.00	-17.50	-13.65
2	1	2.29	0.00	0.00	-18.78	-12.37
3	1	1.14	0.00	0.00	-19.42	-11.73

```
 4: 1:        0.23 :   0.00:     0.00:  -20.70:  -10.45:
 5: 1:        0.04 :   0.00:     0.00:  -21.99:   -9.17:
 6: 1:        0.01 :   0.00:     0.00:  -23.27:   -7.88:
 7: 1:        0.00 :   0.00:     0.00:  -24.55:   -6.60:
 8: 1:        0.00 :   0.00:     0.00:  -25.83:   -5.32:
 9: 1:        0.00 :   0.00:     0.00:  -27.11:   -4.04:
10: 1:        0.00 :   0.00:     0.00:  -28.40:   -2.76:
S  : M: NUMBER     :        S2         :        S          :
T  : A:  OF        :                   :                   :
E  : T: FATIGUE    :      (ksi)        :      (ksi)        :
P  : L: CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:------------:---------:---------:---------:---------:
 1: 1:       19.14 :   0.00:     0.00:     0.00:     0.00:
 2: 1:        2.29 :   0.00:     0.00:     0.00:     0.00:
 3: 1:        1.14 :   0.00:     0.00:     0.00:     0.00:
 4: 1:        0.23 :   0.00:     0.00:     0.00:     0.00:
 5: 1:        0.04 :   0.00:     0.00:     0.00:     0.00:
 6: 1:        0.01 :   0.00:     0.00:     0.00:     0.00:
 7: 1:        0.00 :   0.00:     0.00:     0.00:     0.00:
 8: 1:        0.00 :   0.00:     0.00:     0.00:     0.00:
 9: 1:        0.00 :   0.00:     0.00:     0.00:     0.00:
10: 1:        0.00 :   0.00:     0.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC2, PSE-N3 Nacelle upper longeron rib attach angles        (
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S  : M: NUMBER     :        S0         :        S1         :
T  : A:  OF        :                   :                   :
E  : T: FATIGUE    :      (ksi)        :      (ksi)        :
P  : L: CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:------------:---------:---------:---------:---------:
 1: 1:       38.29 :   0.00:     0.00:  -17.50:  -13.65:
 2: 1:        4.57 :   0.00:     0.00:  -18.78:  -12.37:
 3: 1:        2.29 :   0.00:     0.00:  -19.42:  -11.73:
 4: 1:        0.46 :   0.00:     0.00:  -20.70:  -10.45:
 5: 1:        0.08 :   0.00:     0.00:  -21.99:   -9.17:
 6: 1:        0.02 :   0.00:     0.00:  -23.27:   -7.88:
 7: 1:        0.01 :   0.00:     0.00:  -24.55:   -6.60:
 8: 1:        0.00 :   0.00:     0.00:  -25.83:   -5.32:
 9: 1:        0.00 :   0.00:     0.00:  -27.11:   -4.04:
10: 1:        0.00 :   0.00:     0.00:  -28.40:   -2.76:
S  : M: NUMBER     :        S2         :        S          :
T  : A:  OF        :                   :                   :
E  : T: FATIGUE    :      (ksi)        :      (ksi)        :
P  : L: CYCLES     :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:------------:---------:---------:---------:---------:
 1: 1:       38.29 :   0.00:     0.00:     0.00:     0.00:
 2: 1:        4.57 :   0.00:     0.00:     0.00:     0.00:
 3: 1:        2.29 :   0.00:     0.00:     0.00:     0.00:
 4: 1:        0.46 :   0.00:     0.00:     0.00:     0.00:
 5: 1:        0.08 :   0.00:     0.00:     0.00:     0.00:
 6: 1:        0.02 :   0.00:     0.00:     0.00:     0.00:
 7: 1:        0.01 :   0.00:     0.00:     0.00:     0.00:
 8: 1:        0.00 :   0.00:     0.00:     0.00:     0.00:
 9: 1:        0.00 :   0.00:     0.00:     0.00:     0.00:
10: 1:        0.00 :   0.00:     0.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 TC2, PSE-N3 Nacelle upper longeron rib attach angles        (
MODEL: TC02
```

C-17 PSE N3 Upper Longeron at Wing Rib Attach Angle (Continued)

```
FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
S   : M:  NUMBER       :         S0          :         S1          :
T   : A:    OF         :                     :                     :
E   : T:  FATIGUE      :       (ksi)         :       (ksi)         :
P   : L:  CYCLES       :   (t1) :   (t2)     :   (t1) :   (t2)     :
----:--:---------------:---------:---------:---------:---------:
   1: 1:          0.28 :   0.00:     0.00:     2.83:      2.86:
   2: 1:          0.44 :   0.00:     0.00:    -5.21:     13.13:
   3: 1:          0.22 :   0.00:     0.00:   -13.27:     23.43:
   4: 1:          0.06 :   0.00:     0.00:   -21.31:     33.73:
   5: 1:          0.00 :   0.00:     0.00:   -29.35:     44.03:
   6: 1:          0.00 :   0.00:     0.00:   -37.41:     54.34:
S   : M:  NUMBER       :         S2          :         S           :
T   : A:    OF         :                     :                     :
E   : T:  FATIGUE      :       (ksi)         :       (ksi)         :
P   : L:  CYCLES       :   (t1) :   (t2)     :   (t1) :   (t2)     :
----:--:---------------:---------:---------:---------:---------:
   1: 1:          0.28 :   0.00:     0.00:     0.00:      0.00:
   2: 1:          0.44 :   0.00:     0.00:     0.00:      0.00:
   3: 1:          0.22 :   0.00:     0.00:     0.00:      0.00:
   4: 1:          0.06 :   0.00:     0.00:     0.00:      0.00:
   5: 1:          0.00 :   0.00:     0.00:     0.00:      0.00:
   6: 1:          0.00 :   0.00:     0.00:     0.00:      0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                         -------
 TC2, PSE-N3 Nacelle upper longeron rib attach angles      (
MODEL: TC02

ANALYSIS RESULTS:
-----------------


ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.    6
Step description:
of Block No.      3  of Schedule No.      1
Crack Size      c =  0.500003E-01
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
100	15		0.050181	12.136102
200	15		0.050364	12.158290
300	15		0.050548	12.180599
400	15		0.050733	12.203028
500	15		0.050919	12.225580
600	15		0.051107	12.248255
700	15		0.051296	12.271054
800	15		0.051487	12.293979
900	15		0.051679	12.317030
1000	15		0.051872	12.340208
1100	15		0.052067	12.363515
1200	15		0.052264	12.386953
1300	15		0.052461	12.410521
1400	15		0.052661	12.434221
1500	15		0.052861	12.458054
1600	15		0.053064	12.482022
1700	15		0.053267	12.506126
1800	15		0.053473	12.530366
1900	15		0.053680	12.554745
2000	15		0.053888	12.579263
2100	15		0.054098	12.603922
2200	15		0.054310	12.628723

2300	15	0.054523	12.653667
2400	15	0.054738	12.678755
2500	15	0.054955	12.703990
2600	15	0.055173	12.729372
2700	15	0.055393	12.754902
2800	15	0.055615	12.780583
2900	15	0.055838	12.806415
3000	15	0.056063	12.832399
3100	15	0.056290	12.858539
3200	15	0.056519	12.884833
3300	15	0.056750	12.911286
3400	15	0.056982	12.937897
3500	15	0.057217	12.964668
3600	15	0.057453	12.991601
3700	15	0.057691	13.018698
3800	15	0.057931	13.045959
3900	15	0.058173	13.073387
4000	15	0.058417	13.100984
4100	15	0.058663	13.128750
4200	15	0.058911	13.156688
4300	15	0.059161	13.184799
4400	15	0.059415	13.213229
4500	15	0.059673	13.242093
4600	15	0.059934	13.271286
4700	15	0.060199	13.300781
4800	15	0.060467	13.330565
4900	15	0.060738	13.360631
5000	15	0.061012	13.390974

TC2, PSE-N3 Nacelle upper longeron rib attach angles (
MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
5100	15		0.061289	13.421593
5200	15		0.061569	13.452485
5300	15		0.061852	13.483650
5400	15		0.062139	13.515087
5500	15		0.062428	13.546799
5600	15		0.062721	13.578784
5700	15		0.063017	13.611046
5800	15		0.063316	13.643584
5900	15		0.063619	13.676401
6000	15		0.063924	13.709499
6100	15		0.064233	13.742879
6200	15		0.064546	13.776545
6300	15		0.064862	13.810498
6400	15		0.065181	13.844741
6500	15		0.065504	13.879276
6600	15		0.065830	13.914106
6700	15		0.066160	13.949235
6800	15		0.066494	13.984665
6900	15		0.066831	14.020399
7000	15		0.067172	14.056441
7100	15		0.067517	14.092793
7200	15		0.067865	14.129460
7300	15		0.068218	14.166444
7400	15		0.068574	14.203749
7500	15		0.068935	14.241379
7600	15		0.069299	14.279338
7700	15		0.069668	14.317629
7800	15		0.070041	14.356257
7900	15		0.070418	14.395225
8000	15		0.070800	14.434538
8100	15		0.071186	14.474200
8200	15		0.071576	14.514215

C-17 PSE N3 Upper Longeron at Wing Rib Attach Angle (Continued)

8300	15	0.071971	14.554588
8400	15	0.072370	14.595323
8500	15	0.072774	14.636425
8600	15	0.073183	14.677899
8700	15	0.073597	14.719749
8800	15	0.074016	14.761982
8900	15	0.074439	14.804600
9000	15	0.074868	14.847611
9100	15	0.075302	14.891019
9200	15	0.075741	14.934829
9300	15	0.076186	14.979048
9400	15	0.076636	15.023681
9500	15	0.077091	15.068733
9600	15	0.077552	15.114211
9700	15	0.078019	15.160121
9800	15	0.078492	15.206469
9900	15	0.078970	15.253261
10000	15	0.079455	15.300504

TC2, PSE-N3 Nacelle upper longeron rib attach angles (
MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
10100	15		0.079945	15.348204
10200	15		0.080442	15.396368
10300	15		0.080945	15.445004
10400	15		0.081455	15.494118
10500	15		0.081972	15.543717
10600	15		0.082495	15.593809
10700	15		0.083025	15.644401
10800	15		0.083561	15.695502
10900	15		0.084105	15.747119
11000	15		0.084657	15.799261
11100	15		0.085215	15.851935
11200	15		0.085781	15.905150
11300	15		0.086355	15.958915
11400	15		0.086937	16.013239
11500	15		0.087526	16.068131
11600	15		0.088124	16.123601
11700	15		0.088730	16.179657
11800	15		0.089344	16.236310
11900	15		0.089968	16.293570
12000	15		0.090599	16.351447
12100	15		0.091240	16.409952
12200	15		0.091890	16.469095
12300	15		0.092550	16.528888
12400	15		0.093219	16.589343
12500	15		0.093898	16.650470
12600	15		0.094586	16.712281
12700	15		0.095285	16.774790
12800	15		0.095995	16.838009
12900	15		0.096715	16.901950
13000	15		0.097446	16.966627
13100	15		0.098188	17.032054
13200	15		0.098941	17.098245
13300	15		0.099706	17.165213
13400	15		0.100483	17.232975
13500	15		0.101272	17.301544
13600	15		0.102073	17.370937
13700	15		0.102887	17.441170
13800	15		0.103715	17.512259
13900	15		0.104555	17.584222
14000	15		0.105409	17.657075
14100	15		0.106278	17.730838
14200	15		0.107160	17.805527

14300	15	0.108057	17.881163
14400	15	0.108969	17.957765
14500	15	0.109897	18.035353
14600	15	0.110840	18.113948
14700	15	0.111800	18.193572
14800	15	0.112776	18.274247
14900	15	0.113769	18.355995
15000	15	0.114780	18.438840

TC2, PSE-N3 Nacelle upper longeron rib attach angles (
MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
15100	15		0.115809	18.522807
15200	15		0.116855	18.607921
15300	15		0.117921	18.694206
15400	15		0.119007	18.781691
15500	15		0.120112	18.870403
15600	15		0.121237	18.960371
15700	15		0.122384	19.051623
15800	15		0.123552	19.144191
15900	15		0.124743	19.238106
16000	15		0.125956	19.333400
16100	15		0.127193	19.430109
16200	15		0.128454	19.528266
16300	15		0.129740	19.627908
16400	15		0.131052	19.729072
16500	15		0.132390	19.831799
16600	15		0.133755	19.936127
16700	15		0.135149	20.042100
16800	15		0.136571	20.149761
16900	15		0.138023	20.259155
17000	15		0.139506	20.370330
17100	15		0.141021	20.483333
17200	15		0.142568	20.598217
17300	15		0.144150	20.715034
17400	15		0.145766	20.833840
17500	15		0.147418	20.954692
17600	15		0.149108	21.077649
17700	15		0.150836	21.202775
17800	15		0.152605	21.330135
17900	15		0.154415	21.459796
18000	15		0.156267	21.591831
18100	15		0.158165	21.726312
18200	15		0.160108	21.863319
18300	15		0.162099	22.002932
18400	15		0.164139	22.145238
18500	15		0.166231	22.290325
18600	15		0.168376	22.438287
18700	15		0.170577	22.589223
18800	15		0.172836	22.743236
18900	15		0.175154	22.900435
19000	15		0.177535	23.060934
19100	15		0.179981	23.224855
19200	15		0.182495	23.392324
19300	15		0.185079	23.563476
19400	15		0.187738	23.738452
19500	15		0.190473	23.917401
19600	15		0.193289	24.100483
19700	15		0.196189	24.287865
19800	15		0.199177	24.479726
19900	15		0.202257	24.676254
20000	15		0.205434	24.877651

TC2, PSE-N3 Nacelle upper longeron rib attach angles (
MODEL: TC02

C-17 PSE N3 Upper Longeron at Wing Rib Attach Angle (Continued)

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
20100	15		0.208712	25.084130
20200	15		0.212097	25.295919
20300	15		0.215594	25.513263
20400	15		0.219208	25.736421
20500	15		0.222947	25.965672
20600	15		0.226816	26.201314
20700	15		0.230822	26.443668
20800	15		0.234975	26.693079
20900	15		0.239281	26.949918
21000	15		0.243751	27.214588
21100	15		0.248393	27.487521
21200	15		0.253219	27.769191
21300	15		0.258241	28.060106
21400	15		0.263470	28.360827
21500	15		0.268922	28.671959
21600	15		0.274610	28.994171
21700	15		0.280553	29.328194
21800	15		0.286767	29.674834
21900	15		0.293275	30.034980
22000	15		0.300098	30.409621
22100	15		0.307262	30.799855
22200	15		0.314794	31.206910
22300	15		0.322727	31.632163
22400	15		0.331096	32.077167
22500	15		0.339941	32.543682
22600	15		0.349308	33.033713
22700	15		0.359250	33.549558
22800	15		0.369827	34.093870
22900	15		0.381108	34.669731
23000	15		0.393177	35.280751
23100	15		0.406129	35.931203
23200	15		0.420078	36.626187
23300	15		0.435163	37.371865
23400	15		0.451551	38.175785
23500	15		0.469449	39.047324
23600	15		0.489116	39.998350

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No. 6
Step description:
of Block No. 15 of Schedule No. 23631
Crack Size c = 0.495619

C-18 PSE H1 Horizontal Stabilizer Rib Strap at Rear Spar BL 3.1

```
                    FATIGUE CRACK GROWTH ANALYSIS
                  -----------------------------
                 DATE: 08/11/98    TIME: 13:10:57
         (computed: NASA/FLAGRO Version 2.03, March 1995.)
         U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 3, PSE-H1 hole crack in splice strap

GEOMETRY
--------
MODEL: TC03-Through crack from hole in plate.

Plate Thickness, t =    0.1250
  "   Width, W     =    1.0000
Hole Diameter, D   =    0.1900
Hole-Center-to-Edge Dist., B =    0.5000

FLAW SIZE:

c   (init.) =  0.5000E-01



MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  66.0:  53.0:  46.0:  33.0: 1.00: 1.00:  0.125:  65.5:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:----------:-----:----:----:------:------:-----:-----:
:  1 :0.829E-08:3.284:0.50:1.00:  2.90:  0.70: 1.50: 0.30:
 THROUGH CRACK CASE 3, PSE-H1 hole crack in splice strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   0.54000
Scale Factor for Stress S3:    1.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:    1.7100
Scale Factor for Stress S3:    3.1500
```

C-18 PSE H1 Horizontal Stabilizer Rib Strap at Rear Spar BL 3.1 (Continued)

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 1.7100
Scale Factor for Stress S3: 3.1500

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 1.7100
Scale Factor for Stress S3: 3.1500

Stress Scaling Factors for Block Case: 5

Scale Factor for Stress S0: 1.4400
Scale Factor for Stress S3: 2.6700

Total No. of Blocks in Schedule = 15

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	1	1
2	-	2	2
3	-	3	5
4	-	4	1
5	-	5	3
6	-	6	5
7	-	7	1
8	-	8	3
9	-	9	5
10	-	10	1
11	-	11	3
12	-	12	5
13	-	13	1
14	-	14	4
15	-	15	5

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	9.57	0.02	0.62	0.02	0.62
2	1	1.14	-0.18	0.82	-0.18	0.82
3	1	0.57	-0.28	0.92	-0.28	0.92
4	1	0.11	-0.48	1.12	-0.48	1.12
5	1	0.02	-0.68	1.32	-0.68	1.32
6	1	0.01	-0.88	1.52	-0.88	1.52
7	1	0.00	-1.08	1.72	-1.08	1.72
8	1	0.00	-1.28	1.92	-1.28	1.92
9	1	0.00	-1.48	2.12	-1.48	2.12
10	1	0.00	-1.68	2.32	-1.68	2.32

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	0.02	0.62	0.02	0.62
2	1	2.29	-0.18	0.82	-0.18	0.82
3	1	1.14	-0.28	0.92	-0.28	0.92
4	1	0.23	-0.48	1.12	-0.48	1.12
5	1	0.04	-0.68	1.32	-0.68	1.32
6	1	0.01	-0.88	1.52	-0.88	1.52
7	1	0.00	-1.08	1.72	-1.08	1.72
8	1	0.00	-1.28	1.92	-1.28	1.92
9	1	0.00	-1.48	2.12	-1.48	2.12
10	1	0.00	-1.68	2.32	-1.68	2.32

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	0.02	0.62	0.02	0.62
2	1	4.57	-0.18	0.82	-0.18	0.82
3	1	2.29	-0.28	0.92	-0.28	0.92
4	1	0.46	-0.48	1.12	-0.48	1.12
5	1	0.08	-0.68	1.32	-0.68	1.32
6	1	0.02	-0.88	1.52	-0.88	1.52
7	1	0.01	-1.08	1.72	-1.08	1.72
8	1	0.00	-1.28	1.92	-1.28	1.92
9	1	0.00	-1.48	2.12	-1.48	2.12
10	1	0.00	-1.68	2.32	-1.68	2.32

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	624.00	-0.30	1.00	-0.30	1.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-H1 hole crack in splice strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	0.38	0.70	0.70	1.30
2	1	0.09	0.32	0.76	0.60	1.40
3	1	0.01	0.29	0.79	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-H1 hole crack in splice strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	0.03	1.06	0.06	1.95
2	1	1.14	-0.31	1.40	-0.57	2.58
3	1	0.57	-0.48	1.57	-0.88	2.90
4	1	0.11	-0.82	1.92	-1.51	3.53
5	1	0.02	-1.16	2.26	-2.14	4.16
6	1	0.01	-1.50	2.60	-2.77	4.79
7	1	0.00	-1.85	2.94	-3.40	5.42
8	1	0.00	-2.19	3.28	-4.03	6.05
9	1	0.00	-2.53	3.63	-4.66	6.68
10	1	0.00	-2.87	3.97	-5.29	7.31

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-H1 hole crack in splice strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	0.03	1.06	0.06	1.95
2	1	2.29	-0.31	1.40	-0.57	2.58
3	1	1.14	-0.48	1.57	-0.88	2.90
4	1	0.23	-0.82	1.92	-1.51	3.53
5	1	0.04	-1.16	2.26	-2.14	4.16
6	1	0.01	-1.50	2.60	-2.77	4.79
7	1	0.00	-1.85	2.94	-3.40	5.42
8	1	0.00	-2.19	3.28	-4.03	6.05
9	1	0.00	-2.53	3.63	-4.66	6.68
10	1	0.00	-2.87	3.97	-5.29	7.31

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-H1 hole crack in splice strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	0.03	1.06	0.06	1.95
2	1	4.57	-0.31	1.40	-0.57	2.58
3	1	2.29	-0.48	1.57	-0.88	2.90
4	1	0.46	-0.82	1.92	-1.51	3.53

5:	1:	0.08 :	-1.16:	2.26:	-2.14:	4.16:
6:	1:	0.02 :	-1.50:	2.60:	-2.77:	4.79:
7:	1:	0.01 :	-1.85:	2.94:	-3.40:	5.42:
8:	1:	0.00 :	-2.19:	3.28:	-4.03:	6.05:
9:	1:	0.00 :	-2.53:	3.63:	-4.66:	6.68:
10:	1:	0.00 :	-2.87:	3.97:	-5.29:	7.31:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-H1 hole crack in splice strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	624.00 :	-0.43:	1.44:	-0.80:	2.67:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-H1 hole crack in splice strap
MODEL: TC03

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
200	15		0.050001	1.568822
400	15		0.050003	1.568823
600	15		0.050004	1.568824
800	15		0.050005	1.568825
1000	15		0.050006	1.568826
1200	15		0.050008	1.568827
1400	15		0.050009	1.568828
1600	15		0.050010	1.568829
1800	15		0.050011	1.568829
2000	15		0.050013	1.568830
2200	15		0.050014	1.568831
2400	15		0.050015	1.568832
2600	15		0.050016	1.568833
2800	15		0.050018	1.568834
3000	15		0.050019	1.568835
3200	15		0.050020	1.568836
3400	15		0.050021	1.568837
3600	15		0.050023	1.568838
3800	15		0.050024	1.568839
4000	15		0.050025	1.568840
4200	15		0.050026	1.568841
4400	15		0.050028	1.568842
4600	15		0.050029	1.568843
4800	15		0.050030	1.568844
5000	15		0.050032	1.568845
5200	15		0.050033	1.568846
5400	15		0.050034	1.568847
5600	15		0.050035	1.568848
5800	15		0.050037	1.568849
6000	15		0.050038	1.568850
6200	15		0.050039	1.568851
6400	15		0.050040	1.568851
6600	15		0.050042	1.568852

6800	15	0.050043	1.568853
7000	15	0.050044	1.568854
7200	15	0.050045	1.568855
7400	15	0.050047	1.568856
7600	15	0.050048	1.568857
7800	15	0.050049	1.568858
8000	15	0.050050	1.568859
8200	15	0.050052	1.568860
8400	15	0.050053	1.568861
8600	15	0.050054	1.568862
8800	15	0.050055	1.568863
9000	15	0.050057	1.568864
9200	15	0.050058	1.568865
9400	15	0.050059	1.568866
9600	15	0.050060	1.568867
9800	15	0.050062	1.568868
10000	15	0.050063	1.568869

THROUGH CRACK CASE 3, PSE-H1 hole crack in splice strap
MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block Step	Final Flaw Size c	K max c-tip
10200	15	0.050064	1.568870
10400	15	0.050066	1.568871
10600	15	0.050067	1.568872
10800	15	0.050068	1.568873
11000	15	0.050069	1.568873
11200	15	0.050071	1.568874
11400	15	0.050072	1.568875
11600	15	0.050073	1.568876
11800	15	0.050074	1.568877
12000	15	0.050076	1.568878
12200	15	0.050077	1.568879
12400	15	0.050078	1.568880
12600	15	0.050079	1.568881
12800	15	0.050081	1.568882
13000	15	0.050082	1.568883
13200	15	0.050083	1.568884
13400	15	0.050084	1.568885
13600	15	0.050086	1.568886
13800	15	0.050087	1.568887
14000	15	0.050088	1.568888
14200	15	0.050089	1.568889
14400	15	0.050091	1.568890
14600	15	0.050092	1.568891
14800	15	0.050093	1.568892
15000	15	0.050095	1.568893
15200	15	0.050096	1.568893
15400	15	0.050097	1.568894
15600	15	0.050098	1.568895
15800	15	0.050100	1.568896
16000	15	0.050101	1.568897
16200	15	0.050102	1.568898
16400	15	0.050103	1.568899
16600	15	0.050105	1.568900
16800	15	0.050106	1.568901
17000	15	0.050107	1.568902
17200	15	0.050108	1.568903
17400	15	0.050110	1.568904
17600	15	0.050111	1.568905
17800	15	0.050112	1.568906
18000	15	0.050113	1.568907
18200	15	0.050115	1.568908
18400	15	0.050116	1.568909
18600	15	0.050117	1.568910

18800	15	0.050118	1.568911
19000	15	0.050120	1.568912
19200	15	0.050121	1.568913
19400	15	0.050122	1.568913
19600	15	0.050124	1.568914
19800	15	0.050125	1.568915
20000	15	0.050126	1.568916

THROUGH CRACK CASE 3, PSE-H1 hole crack in splice strap
MODEL: TC03

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
20200	15		0.050127	1.568917
20400	15		0.050129	1.568918
20600	15		0.050130	1.568919
20800	15		0.050131	1.568920
21000	15		0.050132	1.568921

FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No. 624.00 of Load Step No. 1
Step description:
of Block No. 15 of Schedule No. 21000
Crack Size c = 0.501323E-01

C-19 PSE H2 Pitch Trim Actuator Fitting

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    -----------------------------
                  DATE: 09/14/98    TIME: 09:12:15
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING

GEOMETRY
--------
MODEL: TC02-Single edge through crack.

Plate Thickness, t =    0.2700
  "   Width, W     =    1.1240

FLAW SIZE:

c   (init.) =  0.5000E-01



MATERIAL
--------

MATL 1: 2024-T351
        Plt & Sht; T-L; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  68.0:  52.0:  41.0:  29.0: 1.00: 1.00:  0.270:  54.7:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:----------:-----:----:----:------:------:-----:-----:
:  1 :0.922E-08:3.353:0.50:1.00:  2.60:  0.70: 1.50: 0.30:
 TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING
MODEL: TC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:   0.00000
Scale Factor for Stress S2:    2.0000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:   0.00000
Scale Factor for Stress S2:    2.0000
```

C-19 PSE H2 Pitch Trim Actuator Fitting (Continued)

```
Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:   0.00000
Scale Factor for Stress S2:    2.0000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:   0.00000
Scale Factor for Stress S2:    2.0000

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S1:   0.00000
Scale Factor for Stress S2:    2.0000

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
    1   -      1                        1
    2   -      2                        2
    3   -      3                        5
    4   -      4                        1
    5   -      5                        3
    6   -      6                        5
    7   -      7                        1
    8   -      8                        3
    9   -      9                        5
   10   -     10                        1
   11   -     11                        3
   12   -     12                        5
   13   -     13                        1
   14   -     14                        4
   15   -     15                        5

BLOCK CASE NO.  1
 S  : M:  NUMBER      :         S0          :         S1          :
 T  : A:   OF         :                     :                     :
 E  : T:  FATIGUE     :                     :                     :
 P  : L:  CYCLES      :   (t1)  :  (t2)     :   (t1)  :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:    0.70:     1.30:
   2: 1:         0.09 :    0.60:     1.40:    0.60:     1.40:
   3: 1:         0.01 :    0.54:     1.46:    0.54:     1.46:
 S  : M:  NUMBER      :         S2          :         S           :
 T  : A:   OF         :                     :                     :
 E  : T:  FATIGUE     :                     :                     :
 P  : L:  CYCLES      :   (t1)  :  (t2)     :   (t1)  :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :    0.70:     1.30:    0.00:     0.00:
   2: 1:         0.09 :    0.60:     1.40:    0.00:     0.00:
   3: 1:         0.01 :    0.54:     1.46:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER      :         S0          :         S1          :
 T  : A:   OF         :                     :                     :
 E  : T:  FATIGUE     :                     :                     :
 P  : L:  CYCLES      :   (t1)  :  (t2)     :   (t1)  :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :    0.70:     1.30:    0.70:     1.30:
   2: 1:         1.14 :    0.50:     1.50:    0.50:     1.50:
```

C-19 PSE H2 Pitch Trim Actuator Fitting (Continued)

3	1	0.57	0.40	1.60	0.40	1.60
4	1	0.11	0.20	1.80	0.20	1.80
5	1	0.02	0.00	2.00	0.00	2.00
6	1	0.01	-0.20	2.20	-0.20	2.20
7	1	0.00	-0.40	2.40	-0.40	2.40
8	1	0.00	-0.60	2.60	-0.60	2.60
9	1	0.00	-0.80	2.80	-0.80	2.80
10	1	0.00	-1.00	3.00	-1.00	3.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	9.57	0.70	1.30	0.00	0.00
2	1	1.14	0.50	1.50	0.00	0.00
3	1	0.57	0.40	1.60	0.00	0.00
4	1	0.11	0.20	1.80	0.00	0.00
5	1	0.02	0.00	2.00	0.00	0.00
6	1	0.01	-0.20	2.20	0.00	0.00
7	1	0.00	-0.40	2.40	0.00	0.00
8	1	0.00	-0.60	2.60	0.00	0.00
9	1	0.00	-0.80	2.80	0.00	0.00
10	1	0.00	-1.00	3.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	19.14	0.70	1.30	0.70	1.30
2	1	2.29	0.50	1.50	0.50	1.50
3	1	1.14	0.40	1.60	0.40	1.60
4	1	0.23	0.20	1.80	0.20	1.80
5	1	0.04	0.00	2.00	0.00	2.00
6	1	0.01	-0.20	2.20	-0.20	2.20
7	1	0.00	-0.40	2.40	-0.40	2.40
8	1	0.00	-0.60	2.60	-0.60	2.60
9	1	0.00	-0.80	2.80	-0.80	2.80
10	1	0.00	-1.00	3.00	-1.00	3.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	19.14	0.70	1.30	0.00	0.00
2	1	2.29	0.50	1.50	0.00	0.00
3	1	1.14	0.40	1.60	0.00	0.00
4	1	0.23	0.20	1.80	0.00	0.00
5	1	0.04	0.00	2.00	0.00	0.00
6	1	0.01	-0.20	2.20	0.00	0.00
7	1	0.00	-0.40	2.40	0.00	0.00
8	1	0.00	-0.60	2.60	0.00	0.00
9	1	0.00	-0.80	2.80	0.00	0.00
10	1	0.00	-1.00	3.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)

C-19 PSE H2 Pitch Trim Actuator Fitting (Continued)

1	1	38.29	0.70	1.30	0.70	1.30
2	1	4.57	0.50	1.50	0.50	1.50
3	1	2.29	0.40	1.60	0.40	1.60
4	1	0.46	0.20	1.80	0.20	1.80
5	1	0.08	0.00	2.00	0.00	2.00
6	1	0.02	-0.20	2.20	-0.20	2.20
7	1	0.01	-0.40	2.40	-0.40	2.40
8	1	0.00	-0.60	2.60	-0.60	2.60
9	1	0.00	-0.80	2.80	-0.80	2.80
10	1	0.00	-1.00	3.00	-1.00	3.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	38.29	0.70	1.30	0.00	0.00
2	1	4.57	0.50	1.50	0.00	0.00
3	1	2.29	0.40	1.60	0.00	0.00
4	1	0.46	0.20	1.80	0.00	0.00
5	1	0.08	0.00	2.00	0.00	0.00
6	1	0.02	-0.20	2.20	0.00	0.00
7	1	0.01	-0.40	2.40	0.00	0.00
8	1	0.00	-0.60	2.60	0.00	0.00
9	1	0.00	-0.80	2.80	0.00	0.00
10	1	0.00	-1.00	3.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S1 (t1)	S1 (t2)
1	1	0.28	0.45	1.55	0.45	1.55
2	1	0.44	0.43	1.57	0.43	1.57
3	1	0.22	0.38	1.62	0.38	1.62
4	1	0.06	0.30	1.70	0.30	1.70
5	1	0.00	0.18	1.82	0.18	1.82
6	1	0.00	0.02	1.98	0.02	1.98

STEP	MAT	NUMBER OF FATIGUE CYCLES	S2 (t1)	S2 (t2)	S (t1)	S (t2)
1	1	0.28	0.45	1.55	0.00	0.00
2	1	0.44	0.43	1.57	0.00	0.00
3	1	0.22	0.38	1.62	0.00	0.00
4	1	0.06	0.30	1.70	0.00	0.00
5	1	0.00	0.18	1.82	0.00	0.00
6	1	0.00	0.02	1.98	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)

C-19 PSE H2 Pitch Trim Actuator Fitting (Continued)

1	1	1.90	0.00	0.00	0.00	0.00
2	1	0.09	0.00	0.00	0.00	0.00
3	1	0.01	0.00	0.00	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.90	1.40	2.60	0.00	0.00
2	1	0.09	1.20	2.80	0.00	0.00
3	1	0.01	1.08	2.92	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	9.57	0.00	0.00	0.00	0.00
2	1	1.14	0.00	0.00	0.00	0.00
3	1	0.57	0.00	0.00	0.00	0.00
4	1	0.11	0.00	0.00	0.00	0.00
5	1	0.02	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	1.40	2.60	0.00	0.00
2	1	1.14	1.00	3.00	0.00	0.00
3	1	0.57	0.80	3.20	0.00	0.00
4	1	0.11	0.40	3.60	0.00	0.00
5	1	0.02	0.00	4.00	0.00	0.00
6	1	0.01	-0.40	4.40	0.00	0.00
7	1	0.00	-0.80	4.80	0.00	0.00
8	1	0.00	-1.20	5.20	0.00	0.00
9	1	0.00	-1.60	5.60	0.00	0.00
10	1	0.00	-2.00	6.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	19.14	0.00	0.00	0.00	0.00
2	1	2.29	0.00	0.00	0.00	0.00
3	1	1.14	0.00	0.00	0.00	0.00

4	1	0.23	0.00	0.00	0.00	0.00
5	1	0.04	0.00	0.00	0.00	0.00
6	1	0.01	0.00	0.00	0.00	0.00
7	1	0.00	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	1.40	2.60	0.00	0.00
2	1	2.29	1.00	3.00	0.00	0.00
3	1	1.14	0.80	3.20	0.00	0.00
4	1	0.23	0.40	3.60	0.00	0.00
5	1	0.04	0.00	4.00	0.00	0.00
6	1	0.01	-0.40	4.40	0.00	0.00
7	1	0.00	-0.80	4.80	0.00	0.00
8	1	0.00	-1.20	5.20	0.00	0.00
9	1	0.00	-1.60	5.60	0.00	0.00
10	1	0.00	-2.00	6.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	38.29	0.00	0.00	0.00	0.00
2	1	4.57	0.00	0.00	0.00	0.00
3	1	2.29	0.00	0.00	0.00	0.00
4	1	0.46	0.00	0.00	0.00	0.00
5	1	0.08	0.00	0.00	0.00	0.00
6	1	0.02	0.00	0.00	0.00	0.00
7	1	0.01	0.00	0.00	0.00	0.00
8	1	0.00	0.00	0.00	0.00	0.00
9	1	0.00	0.00	0.00	0.00	0.00
10	1	0.00	0.00	0.00	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	38.29	1.40	2.60	0.00	0.00
2	1	4.57	1.00	3.00	0.00	0.00
3	1	2.29	0.80	3.20	0.00	0.00
4	1	0.46	0.40	3.60	0.00	0.00
5	1	0.08	0.00	4.00	0.00	0.00
6	1	0.02	-0.40	4.40	0.00	0.00
7	1	0.01	-0.80	4.80	0.00	0.00
8	1	0.00	-1.20	5.20	0.00	0.00
9	1	0.00	-1.60	5.60	0.00	0.00
10	1	0.00	-2.00	6.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING
MODEL: TC02

C-19 PSE H2 Pitch Trim Actuator Fitting (Continued)

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S1 (ksi) (t1)	S1 (ksi) (t2)
1	1	0.28	0.00	0.00	0.00	0.00
2	1	0.44	0.00	0.00	0.00	0.00
3	1	0.22	0.00	0.00	0.00	0.00
4	1	0.06	0.00	0.00	0.00	0.00
5	1	0.00	0.00	0.00	0.00	0.00
6	1	0.00	0.00	0.00	0.00	0.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S2 (ksi) (t1)	S2 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	0.28	0.90	3.10	0.00	0.00
2	1	0.44	0.86	3.14	0.00	0.00
3	1	0.22	0.76	3.24	0.00	0.00
4	1	0.06	0.60	3.40	0.00	0.00
5	1	0.00	0.36	3.64	0.00	0.00
6	1	0.00	0.04	3.96	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING
MODEL: TC02

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
100	15		0.050000	1.687937
200	15		0.050000	1.687937
300	15		0.050000	1.687937
400	15		0.050000	1.687937
500	15		0.050000	1.687937
600	15		0.050000	1.687937
700	15		0.050000	1.687937
800	15		0.050000	1.687937
900	15		0.050000	1.687938
1000	15		0.050000	1.687938
1100	15		0.050000	1.687938
1200	15		0.050000	1.687938
1300	15		0.050000	1.687938
1400	15		0.050000	1.687938
1500	15		0.050000	1.687938
1600	15		0.050000	1.687938
1700	15		0.050000	1.687938
1800	15		0.050000	1.687938
1900	15		0.050000	1.687939
2000	15		0.050000	1.687939
2100	15		0.050000	1.687939
2200	15		0.050000	1.687939
2300	15		0.050000	1.687939
2400	15		0.050000	1.687939
2500	15		0.050000	1.687939
2600	15		0.050000	1.687939
2700	15		0.050000	1.687939
2800	15		0.050000	1.687939
2900	15		0.050000	1.687939
3000	15		0.050000	1.687940

C-19 PSE H2 Pitch Trim Actuator Fitting (Continued)

3100	15	0.050000	1.687940
3200	15	0.050000	1.687940
3300	15	0.050000	1.687940
3400	15	0.050000	1.687940
3500	15	0.050000	1.687940
3600	15	0.050000	1.687940
3700	15	0.050000	1.687940
3800	15	0.050000	1.687940
3900	15	0.050000	1.687940
4000	15	0.050000	1.687941
4100	15	0.050000	1.687941
4200	15	0.050000	1.687941
4300	15	0.050000	1.687941
4400	15	0.050000	1.687941
4500	15	0.050000	1.687941
4600	15	0.050000	1.687941
4700	15	0.050000	1.687941
4800	15	0.050000	1.687941
4900	15	0.050000	1.687941
5000	15	0.050000	1.687941

TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING
MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
5100	15		0.050000	1.687942
5200	15		0.050000	1.687942
5300	15		0.050000	1.687942
5400	15		0.050000	1.687942
5500	15		0.050000	1.687942
5600	15		0.050000	1.687942
5700	15		0.050000	1.687942
5800	15		0.050000	1.687942
5900	15		0.050000	1.687942
6000	15		0.050000	1.687942
6100	15		0.050000	1.687943
6200	15		0.050000	1.687943
6300	15		0.050000	1.687943
6400	15		0.050000	1.687943
6500	15		0.050000	1.687943
6600	15		0.050000	1.687943
6700	15		0.050000	1.687943
6800	15		0.050000	1.687943
6900	15		0.050000	1.687943
7000	15		0.050000	1.687943
7100	15		0.050000	1.687943
7200	15		0.050000	1.687944
7300	15		0.050000	1.687944
7400	15		0.050000	1.687944
7500	15		0.050000	1.687944
7600	15		0.050000	1.687944
7700	15		0.050000	1.687944
7800	15		0.050000	1.687944
7900	15		0.050000	1.687944
8000	15		0.050000	1.687944
8100	15		0.050000	1.687944
8200	15		0.050000	1.687945
8300	15		0.050001	1.687945
8400	15		0.050001	1.687945
8500	15		0.050001	1.687945
8600	15		0.050001	1.687945
8700	15		0.050001	1.687945
8800	15		0.050001	1.687945
8900	15		0.050001	1.687945
9000	15		0.050001	1.687945

C-19 PSE H2 Pitch Trim Actuator Fitting (Continued)

9100	15	0.050001	1.687945
9200	15	0.050001	1.687945
9300	15	0.050001	1.687946
9400	15	0.050001	1.687946
9500	15	0.050001	1.687946
9600	15	0.050001	1.687946
9700	15	0.050001	1.687946
9800	15	0.050001	1.687946
9900	15	0.050001	1.687946
10000	15	0.050001	1.687946

TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING
MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block Step	Final Flaw Size c	K max c-tip
10100	15	0.050001	1.687946
10200	15	0.050001	1.687946
10300	15	0.050001	1.687947
10400	15	0.050001	1.687947
10500	15	0.050001	1.687947
10600	15	0.050001	1.687947
10700	15	0.050001	1.687947
10800	15	0.050001	1.687947
10900	15	0.050001	1.687947
11000	15	0.050001	1.687947
11100	15	0.050001	1.687947
11200	15	0.050001	1.687947
11300	15	0.050001	1.687947
11400	15	0.050001	1.687948
11500	15	0.050001	1.687948
11600	15	0.050001	1.687948
11700	15	0.050001	1.687948
11800	15	0.050001	1.687948
11900	15	0.050001	1.687948
12000	15	0.050001	1.687948
12100	15	0.050001	1.687948
12200	15	0.050001	1.687948
12300	15	0.050001	1.687948
12400	15	0.050001	1.687949
12500	15	0.050001	1.687949
12600	15	0.050001	1.687949
12700	15	0.050001	1.687949
12800	15	0.050001	1.687949
12900	15	0.050001	1.687949
13000	15	0.050001	1.687949
13100	15	0.050001	1.687949
13200	15	0.050001	1.687949
13300	15	0.050001	1.687949
13400	15	0.050001	1.687949
13500	15	0.050001	1.687950
13600	15	0.050001	1.687950
13700	15	0.050001	1.687950
13800	15	0.050001	1.687950
13900	15	0.050001	1.687950
14000	15	0.050001	1.687950
14100	15	0.050001	1.687950
14200	15	0.050001	1.687950
14300	15	0.050001	1.687950
14400	15	0.050001	1.687950
14500	15	0.050001	1.687951
14600	15	0.050001	1.687951
14700	15	0.050001	1.687951
14800	15	0.050001	1.687951
14900	15	0.050001	1.687951
15000	15	0.050001	1.687951

TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING
MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
15100	15		0.050001	1.687951
15200	15		0.050001	1.687951
15300	15		0.050001	1.687951
15400	15		0.050001	1.687951
15500	15		0.050001	1.687951
15600	15		0.050001	1.687952
15700	15		0.050001	1.687952
15800	15		0.050001	1.687952
15900	15		0.050001	1.687952
16000	15		0.050001	1.687952
16100	15		0.050001	1.687952
16200	15		0.050001	1.687952
16300	15		0.050001	1.687952
16400	15		0.050001	1.687952
16500	15		0.050001	1.687952
16600	15		0.050001	1.687953
16700	15		0.050001	1.687953
16800	15		0.050001	1.687953
16900	15		0.050001	1.687953
17000	15		0.050001	1.687953
17100	15		0.050001	1.687953
17200	15		0.050001	1.687953
17300	15		0.050001	1.687953
17400	15		0.050001	1.687953
17500	15		0.050001	1.687953
17600	15		0.050001	1.687953
17700	15		0.050001	1.687954
17800	15		0.050001	1.687954
17900	15		0.050001	1.687954
18000	15		0.050001	1.687954
18100	15		0.050001	1.687954
18200	15		0.050001	1.687954
18300	15		0.050001	1.687954
18400	15		0.050001	1.687954
18500	15		0.050001	1.687954
18600	15		0.050001	1.687954
18700	15		0.050001	1.687955
18800	15		0.050001	1.687955
18900	15		0.050001	1.687955
19000	15		0.050001	1.687955
19100	15		0.050001	1.687955
19200	15		0.050001	1.687955
19300	15		0.050001	1.687955
19400	15		0.050001	1.687955
19500	15		0.050001	1.687955
19600	15		0.050001	1.687955
19700	15		0.050001	1.687955
19800	15		0.050001	1.687956
19900	15		0.050001	1.687956
20000	15		0.050001	1.687956

TC2, PSE-H2 HORIZONTAL STAB PITCH TRIM ACTUATOR FITTING
MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
20100	15		0.050001	1.687956

C-19 PSE H2 Pitch Trim Actuator Fitting (Continued)

20200	15	0.050001	1.687956
20300	15	0.050001	1.687956
20400	15	0.050001	1.687956
20500	15	0.050001	1.687956
20600	15	0.050001	1.687956
20700	15	0.050001	1.687956
20800	15	0.050001	1.687957
20900	15	0.050001	1.687957
21000	15	0.050001	1.687957

```
FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No.         0.00  of Load Step No.    6
Step description:
of Block No.      15  of Schedule No.   21000
Crack Size      c =  0.500013E-01
```

C-20 PSE V1 Vertical Fin Main Spar Cap Strips Below Pivot Fitting

```
                    FATIGUE CRACK GROWTH ANALYSIS
                   -----------------------------
                  DATE: 08/17/98    TIME: 13:30:37
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 3, PSE-V1 Case A .090 strap

GEOMETRY
--------
MODEL: TC03-Through crack from hole in plate.

Plate Thickness, t =    0.0900
  "   Width, W     =    1.4000
Hole Diameter, D   =    0.1600
Hole-Center-to-Edge Dist., B =    0.3500

FLAW SIZE:

c   (init.) =  0.5000E-01




MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  66.0:  53.0:  46.0:  33.0: 1.00: 1.00:  0.090:  65.7:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p  :  q  :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :     :     :      :      :     :SIGo :
:----:-----------:-----:-----:-----:------:------:-----:-----:
:  1 :0.829E-08:3.284:0.50:1.00:  2.90:  0.70: 1.50: 0.30:
 THROUGH CRACK CASE 3, PSE-V1 Case A .090 strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    4.3900

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    4.3900
```

```
Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    4.3900

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    4.3900

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    4.4100

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From    -    To
    1   -     1                        1
    2   -     2                        2
    3   -     3                        5
    4   -     4                        1
    5   -     5                        3
    6   -     6                        5
    7   -     7                        1
    8   -     8                        3
    9   -     9                        5
   10   -    10                        1
   11   -    11                        3
   12   -    12                        5
   13   -    13                        1
   14   -    14                        4
   15   -    15                        5

BLOCK CASE NO.  1
 S   : M:  NUMBER      :        S0          :        S3          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :                    :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.90 :   0.70:      1.30:    0.70:      1.30:
   2: 1:         0.09 :   0.60:      1.40:    0.60:      1.40:
   3: 1:         0.01 :   0.54:      1.46:    0.54:      1.46:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                         -------

BLOCK CASE NO.  2
 S   : M:  NUMBER      :        S0          :        S3          :
 T   : A:    OF        :                    :                    :
 E   : T:  FATIGUE     :                    :                    :
 P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :  -0.30:      0.30:   -0.30:      0.30:
   2: 1:         1.14 :  -0.50:      0.50:   -0.50:      0.50:
   3: 1:         0.57 :  -0.60:      0.60:   -0.60:      0.60:
   4: 1:         0.11 :  -0.80:      0.80:   -0.80:      0.80:
   5: 1:         0.02 :  -1.00:      1.00:   -1.00:      1.00:
   6: 1:         0.01 :  -1.20:      1.20:   -1.20:      1.20:
   7: 1:         0.00 :  -1.40:      1.40:   -1.40:      1.40:
   8: 1:         0.00 :  -1.60:      1.60:   -1.60:      1.60:
   9: 1:         0.00 :  -1.80:      1.80:   -1.80:      1.80:
  10: 1:         0.00 :  -2.00:      2.00:   -2.00:      2.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
```

C-20 PSE V1 Vertical Fin Main Spar Cap Strips Below Pivot Fitting (Continued)

BLOCK CASE NO. 3

S T E P	M A T L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	-0.30	0.30	-0.30	0.30
2	1	2.29	-0.50	0.50	-0.50	0.50
3	1	1.14	-0.60	0.60	-0.60	0.60
4	1	0.23	-0.80	0.80	-0.80	0.80
5	1	0.04	-1.00	1.00	-1.00	1.00
6	1	0.01	-1.20	1.20	-1.20	1.20
7	1	0.00	-1.40	1.40	-1.40	1.40
8	1	0.00	-1.60	1.60	-1.60	1.60
9	1	0.00	-1.80	1.80	-1.80	1.80
10	1	0.00	-2.00	2.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

S T E P	M A T L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	-0.30	0.30	-0.30	0.30
2	1	4.57	-0.50	0.50	-0.50	0.50
3	1	2.29	-0.60	0.60	-0.60	0.60
4	1	0.46	-0.80	0.80	-0.80	0.80
5	1	0.08	-1.00	1.00	-1.00	1.00
6	1	0.02	-1.20	1.20	-1.20	1.20
7	1	0.01	-1.40	1.40	-1.40	1.40
8	1	0.00	-1.60	1.60	-1.60	1.60
9	1	0.00	-1.80	1.80	-1.80	1.80
10	1	0.00	-2.00	2.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

S T E P	M A T L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	624.00	-2.20	1.00	-2.20	1.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-V1 Case A .090 strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

S T E P	M A T L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	0.00	0.00	3.07	5.71
2	1	0.09	0.00	0.00	2.63	6.15
3	1	0.01	0.00	0.00	2.37	6.41

C-20 PSE V1 Vertical Fin Main Spar Cap Strips Below Pivot Fitting (Continued)

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-V1 Case A .090 strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	0.00	0.00	-1.32	1.32
2	1	1.14	0.00	0.00	-2.19	2.19
3	1	0.57	0.00	0.00	-2.63	2.63
4	1	0.11	0.00	0.00	-3.51	3.51
5	1	0.02	0.00	0.00	-4.39	4.39
6	1	0.01	0.00	0.00	-5.27	5.27
7	1	0.00	0.00	0.00	-6.15	6.15
8	1	0.00	0.00	0.00	-7.02	7.02
9	1	0.00	0.00	0.00	-7.90	7.90
10	1	0.00	0.00	0.00	-8.78	8.78

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-V1 Case A .090 strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	0.00	0.00	-1.32	1.32
2	1	2.29	0.00	0.00	-2.19	2.19
3	1	1.14	0.00	0.00	-2.63	2.63
4	1	0.23	0.00	0.00	-3.51	3.51
5	1	0.04	0.00	0.00	-4.39	4.39
6	1	0.01	0.00	0.00	-5.27	5.27
7	1	0.00	0.00	0.00	-6.15	6.15
8	1	0.00	0.00	0.00	-7.02	7.02
9	1	0.00	0.00	0.00	-7.90	7.90
10	1	0.00	0.00	0.00	-8.78	8.78

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-V1 Case A .090 strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	0.00	0.00	-1.32	1.32
2	1	4.57	0.00	0.00	-2.19	2.19
3	1	2.29	0.00	0.00	-2.63	2.63
4	1	0.46	0.00	0.00	-3.51	3.51

```
  5: 1:        0.08 :    0.00:     0.00:    -4.39:     4.39:
  6: 1:        0.02 :    0.00:     0.00:    -5.27:     5.27:
  7: 1:        0.01 :    0.00:     0.00:    -6.15:     6.15:
  8: 1:        0.00 :    0.00:     0.00:    -7.02:     7.02:
  9: 1:        0.00 :    0.00:     0.00:    -7.90:     7.90:
 10: 1:        0.00 :    0.00:     0.00:    -8.78:     8.78:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                       -------
 THROUGH CRACK CASE 3, PSE-V1 Case A .090 strap
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
 S  : M:  NUMBER      :        S0         :        S3         :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :      (ksi)        :      (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:      624.00 :    0.00:     0.00:    -9.70:     4.41:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                       -------
 THROUGH CRACK CASE 3, PSE-V1 Case A .090 strap
MODEL: TC03

ANALYSIS RESULTS:
-----------------

FINAL RESULTS:
All Stress Intensities are below the Fatigue Threshold.
NO growth in Schedule No.       1
Crack Size      c =  0.500000E-01



                 FATIGUE CRACK GROWTH ANALYSIS
                -----------------------------
               DATE: 08/17/98    TIME: 13:34:49
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
THROUGH CRACK CASE 3, PSE-V1 Case B .190 Channel

GEOMETRY
--------
MODEL: TC03-Through crack from hole in plate.

Plate Thickness, t =    0.1900
  "   Width, W     =    1.4000
Hole Diameter, D   =    0.1600
Hole-Center-to-Edge Dist., B =    0.3500

FLAW SIZE:

c   (init.) =  0.5000E-01



MATERIAL
--------
```

```
MATL 1: 2014-T6
        Plt & sht; L-T

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 : 74.0: 65.0: 38.0: 27.0: 1.00: 1.00:  0.190: 49.2:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.350E-07:2.800:0.50:1.00:  2.70:  0.70: 1.50: 0.30:
 THROUGH CRACK CASE 3, PSE-V1 Case B .190 Channel
MODEL: TC03

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    3.9300

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    3.9300

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    3.9300

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    3.9300

Stress Scaling Factors for Block Case:  5

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    3.9500

Total No. of Blocks in Schedule =    15

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
    1   -     1                          1
    2   -     2                          2
    3   -     3                          5
    4   -     4                          1
    5   -     5                          3
    6   -     6                          5
    7   -     7                          1
    8   -     8                          3
    9   -     9                          5
   10   -    10                          1
   11   -    11                          3
   12   -    12                          5
   13   -    13                          1
   14   -    14                          4
```

15 - 15 5

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.90	0.70	1.30	0.70	1.30
2	1	0.09	0.60	1.40	0.60	1.40
3	1	0.01	0.54	1.46	0.54	1.46

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	9.57	-0.30	0.30	-0.30	0.30
2	1	1.14	-0.50	0.50	-0.50	0.50
3	1	0.57	-0.60	0.60	-0.60	0.60
4	1	0.11	-0.80	0.80	-0.80	0.80
5	1	0.02	-1.00	1.00	-1.00	1.00
6	1	0.01	-1.20	1.20	-1.20	1.20
7	1	0.00	-1.40	1.40	-1.40	1.40
8	1	0.00	-1.60	1.60	-1.60	1.60
9	1	0.00	-1.80	1.80	-1.80	1.80
10	1	0.00	-2.00	2.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	-0.30	0.30	-0.30	0.30
2	1	2.29	-0.50	0.50	-0.50	0.50
3	1	1.14	-0.60	0.60	-0.60	0.60
4	1	0.23	-0.80	0.80	-0.80	0.80
5	1	0.04	-1.00	1.00	-1.00	1.00
6	1	0.01	-1.20	1.20	-1.20	1.20
7	1	0.00	-1.40	1.40	-1.40	1.40
8	1	0.00	-1.60	1.60	-1.60	1.60
9	1	0.00	-1.80	1.80	-1.80	1.80
10	1	0.00	-2.00	2.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	-0.30	0.30	-0.30	0.30
2	1	4.57	-0.50	0.50	-0.50	0.50
3	1	2.29	-0.60	0.60	-0.60	0.60
4	1	0.46	-0.80	0.80	-0.80	0.80
5	1	0.08	-1.00	1.00	-1.00	1.00

6	1	0.02	-1.20	1.20	-1.20	1.20
7	1	0.01	-1.40	1.40	-1.40	1.40
8	1	0.00	-1.60	1.60	-1.60	1.60
9	1	0.00	-1.80	1.80	-1.80	1.80
10	1	0.00	-2.00	2.00	-2.00	2.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 5

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	624.00	-2.20	1.00	-2.20	1.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-V1 Case B .190 Channel
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.90	0.00	0.00	2.75	5.11
2	1	0.09	0.00	0.00	2.36	5.50
3	1	0.01	0.00	0.00	2.12	5.74

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-V1 Case B .190 Channel
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	0.00	0.00	-1.18	1.18
2	1	1.14	0.00	0.00	-1.97	1.97
3	1	0.57	0.00	0.00	-2.36	2.36
4	1	0.11	0.00	0.00	-3.14	3.14
5	1	0.02	0.00	0.00	-3.93	3.93
6	1	0.01	0.00	0.00	-4.72	4.72
7	1	0.00	0.00	0.00	-5.50	5.50
8	1	0.00	0.00	0.00	-6.29	6.29
9	1	0.00	0.00	0.00	-7.07	7.07
10	1	0.00	0.00	0.00	-7.86	7.86

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-V1 Case B .190 Channel
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

C-20 PSE V1 Vertical Fin Main Spar Cap Strips Below Pivot Fitting (Continued)

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	0.00	0.00	-1.18	1.18
2	1	2.29	0.00	0.00	-1.97	1.97
3	1	1.14	0.00	0.00	-2.36	2.36
4	1	0.23	0.00	0.00	-3.14	3.14
5	1	0.04	0.00	0.00	-3.93	3.93
6	1	0.01	0.00	0.00	-4.72	4.72
7	1	0.00	0.00	0.00	-5.50	5.50
8	1	0.00	0.00	0.00	-6.29	6.29
9	1	0.00	0.00	0.00	-7.07	7.07
10	1	0.00	0.00	0.00	-7.86	7.86

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-V1 Case B .190 Channel
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	0.00	0.00	-1.18	1.18
2	1	4.57	0.00	0.00	-1.97	1.97
3	1	2.29	0.00	0.00	-2.36	2.36
4	1	0.46	0.00	0.00	-3.14	3.14
5	1	0.08	0.00	0.00	-3.93	3.93
6	1	0.02	0.00	0.00	-4.72	4.72
7	1	0.01	0.00	0.00	-5.50	5.50
8	1	0.00	0.00	0.00	-6.29	6.29
9	1	0.00	0.00	0.00	-7.07	7.07
10	1	0.00	0.00	0.00	-7.86	7.86

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-V1 Case B .190 Channel
MODEL: TC03

FATIGUE SCHEDULE BLOCK STRESS TABLE

STD STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	624.00	0.00	0.00	-8.69	3.95

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

THROUGH CRACK CASE 3, PSE-V1 Case B .190 Channel
MODEL: TC03

ANALYSIS RESULTS:

FINAL RESULTS:
All Stress Intensities are below the Fatigue Threshold.

C-20 PSE V1 Vertical Fin Main Spar Cap Strips Below Pivot Fitting (Continued)

```
NO growth in Schedule No.       1
Crack Size      c =  0.500000E-01
```

C-21 PSE F5 SA226 and SA227 Lower Fuse Frame at Cargo Door Latch

```
                    FATIGUE CRACK GROWTH ANALYSIS
                   -----------------------------
                  DATE: 09/16/98    TIME: 10:10:24
          (computed: NASA/FLAGRO Version 2.03, March 1995.)
          U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC2, PSE-F5 crack in .071 FRAME BELT, Gage#34 sa226/sa227

GEOMETRY
--------
MODEL: TC02-Single edge through crack.

Plate Thickness, t =    0.0710
  "   Width, W     =    2.9000

FLAW SIZE:

c   (init.) =  0.5000E-01



MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; T-L; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  65.0:  48.0:  41.0:  29.0: 1.00: 1.00:  0.071:  57.8:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.244E-07:2.601:0.50:1.00:  2.90:  0.70: 1.50: 0.30:
 TC2, PSE-F5 crack in .071 FRAME BELT, Gage#34 sa226/sa227
MODEL: TC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    9.6000
Scale Factor for Stress S1:   0.00000
Scale Factor for Stress S2:   0.00000

Total No. of Blocks in Schedule =      1

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
   1   -     1                        1
```

```
SINGLE DISTINCT BLOCK
 S  : M:  NUMBER      :        S0          :        S1         :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :                    :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     1.00:    0.00:     1.00:
 S  : M:  NUMBER      :        S2          :        S          :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :                    :                   :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     1.00:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                           -------
 TC2, PSE-F5 crack in .071 FRAME BELT, Gage#34 sa226/sa227
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
 S  : M:  NUMBER      :        S0          :        S1         :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :      (ksi)         :      (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     9.60:    0.00:     0.00:
 S  : M:  NUMBER      :        S2          :        S          :
 T  : A:    OF        :                    :                   :
 E  : T:  FATIGUE     :      (ksi)         :      (ksi)        :
 P  : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     0.00:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                           -------
 TC2, PSE-F5 crack in .071 FRAME BELT, Gage#34 sa226/sa227
MODEL: TC02

ANALYSIS RESULTS:
-----------------
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
5000	1		0.050945	4.333221
10000	1		0.051923	4.375170
15000	1		0.052934	4.418178
20000	1		0.053981	4.462281
25000	1		0.055064	4.507519
30000	1		0.056187	4.553931
35000	1		0.057350	4.601560
40000	1		0.058555	4.650450
45000	1		0.059805	4.700647
50000	1		0.061101	4.752201
55000	1		0.062446	4.805165
60000	1		0.063843	4.859591
65000	1		0.065294	4.915539
70000	1		0.066801	4.973069
75000	1		0.068369	5.032245
80000	1		0.069999	5.093137
85000	1		0.071695	5.155816
90000	1		0.073461	5.220360
95000	1		0.075301	5.286849
100000	1		0.077219	5.355371

105000	1	0.079220	5.426019
110000	1	0.081307	5.498890
115000	1	0.083487	5.574092
120000	1	0.085764	5.651735
125000	1	0.088145	5.731942
130000	1	0.090637	5.814841
135000	1	0.093245	5.900573
140000	1	0.095978	5.989287
145000	1	0.098844	6.081145
150000	1	0.101852	6.176324
155000	1	0.105012	6.275012
160000	1	0.108333	6.377416
165000	1	0.111829	6.483760
170000	1	0.115510	6.594292
175000	1	0.119392	6.709277
180000	1	0.123490	6.829013
185000	1	0.127819	6.953825
190000	1	0.132401	7.084070
195000	1	0.137254	7.220150
200000	1	0.142402	7.362507
205000	1	0.147871	7.511639
210000	1	0.153690	7.668104
215000	1	0.159892	7.832534
220000	1	0.166514	8.005645
225000	1	0.173597	8.188255
230000	1	0.181189	8.381304
235000	1	0.189346	8.585882
240000	1	0.198131	8.803258
245000	1	0.207619	9.034924
250000	1	0.217897	9.282654

TC2, PSE-F5 crack in .071 FRAME BELT, Gage#34 sa226/sa227
MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block Step	Final Flaw Size c	K max c-tip
255000	1	0.229067	9.548574
260000	1	0.241253	9.835266
265000	1	0.254604	10.145901
270000	1	0.269303	10.484443
275000	1	0.285575	10.855919
280000	1	0.303710	11.266845
285000	1	0.324076	11.725860
290000	1	0.347166	12.244742
295000	1	0.373649	12.840106
300000	1	0.404473	13.536400
305000	1	0.441051	14.371604
310000	1	0.485626	15.409141
315000	1	0.542102	16.766293
320000	1	0.618312	18.696635
325000	1	0.734438	21.924800
330000	1	0.991525	30.851654

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No. 1
Step description:
of Block No. 1 of Schedule No. 331444
Crack Size c = 1.28902

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No. 1
Step description:

```
of Block No.      1  of Schedule No.  331538
Crack Size     c =   1.39476
```

C-22 PSE F7 SA226 and SA227 Cargo Door Hinge

```
                    FATIGUE CRACK GROWTH ANALYSIS
                   -------Modified by FAI-------
                 DATE: 18-DEC-98    TIME: 10:45:14
         (computed: NASA/FLAGRO Version 2.03, March 1995.)
         U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
CC1, PSE-F7 CARGO DOOR HINGE TAB

GEOMETRY
--------
MODEL: CC01-Corner crack in plate or bar (2D)

Plate Thickness, t =    0.0630
Plate Width, W     =    0.5000

FLAW SIZE:

a   (init.) =  0.5000E-01
c   (init.) =  0.5000E-01
a/c (init.) =   1.000



MATERIAL
--------

MATL 1: 2024-T3511
        Extr; L-T; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  77.0:  55.0:  35.0:  25.0: 1.00: 1.00:  0.063:  49.6:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p  :  q  :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :     :     :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-07:2.700:0.50:1.00:  2.90:  0.70: 1.50: 0.30:

MODEL: CC01

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    23.000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Total No. of Blocks in Schedule =     1

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From   -   To
   1   -     1                       1
```

```
 SINGLE DISTINCT BLOCK
S   : M:  NUMBER     :        S0          :         S1          :
T   : A:    OF       :                    :                     :
E   : T:  FATIGUE    :                    :                     :
P   : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         1.00 :    0.00:     1.00:     0.00:     1.00:
S   : M:  NUMBER     :        S2          :         S           :
T   : A:    OF       :                    :                     :
E   : T:  FATIGUE    :                    :                     :
P   : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         1.00 :    0.00:     1.00:     0.00:     0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CC1, PSE-F7 CARGO DOOR HING
MODEL: CC01

FATIGUE SCHEDULE BLOCK STRESS TABLE

```
STD
S   : M:  NUMBER     :        S0          :         S1          :
T   : A:    OF       :                    :                     :
E   : T:  FATIGUE    :       (ksi)        :        (ksi)        :
P   : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         1.00 :    0.00:    23.00:     0.00:     0.00:
S   : M:  NUMBER     :        S2          :         S           :
T   : A:    OF       :                    :                     :
E   : T:  FATIGUE    :       (ksi)        :        (ksi)        :
P   : L:  CYCLES     :   (t1) :  (t2)     :   (t1) :  (t2)      :
----:--:-------------:---------:---------:---------:---------:
  1: 1:         1.00 :    0.00:     0.00:     0.00:     0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

CC1, PSE-F7 CARGO DOOR HING
MODEL: CC01

ANALYSIS RESULTS:

Schdl	Block	Step	Final Flaw Size a	Final Flaw Size c	K max a-tip	K max c-tip
500	1		0.050540	0.050633	8.191712	8.607663
1000	1		0.051101	0.051293	8.290094	8.717442
1500	1		0.051685	0.051980	8.393507	8.833457
2000	1		0.052293	0.052698	8.502442	8.956346
2500	1		0.052927	0.053450	8.617466	9.086844
3000	1		0.053590	0.054238	8.739233	9.225804
3500	1		0.054284	0.055067	8.868506	9.374218
4000	1		0.055013	0.055941	9.006183	9.533254
4500	1		0.055780	0.056864	9.153327	9.704294
5000	1		0.056589	0.057844	9.311208	9.888991
5500	1		0.057445	0.058888	9.481368	10.089338
6000	1		0.058355	0.060003	9.665688	10.307773
6500	1		0.059324	0.061202	9.866509	10.547309
7000	1		0.060363	0.062496	10.086779	10.811732
7500	1		0.061482	0.063904	10.330284	11.105874
8000	1		0.062694	0.065445	10.601989	11.436037

Transition to 1-d solution, TC02:
a =   0.6300E-01 t =   0.6300E-01

C-22 PSE F7 SA226 and SA227 Cargo Door Hinge (Continued)

```
at Cycle No.        1.00  of Load Step No.   1
Step description:
of Block No.      1  of Schedule No.    8120
Crack Size:  c =  0.658394E-01 ,  a/c =  0.956905
```

Schedl	Block	Step	Final Flaw Size c	K max c-tip
8500	1		0.068287	13.277097
9000	1		0.071823	13.740216
9500	1		0.075790	14.263913
10000	1		0.080292	14.865156
10500	1		0.085480	15.568935
11000	1		0.091578	16.414153
11500	1		0.098946	17.466027
12000	1		0.108219	18.846118
12500	1		0.120703	20.821797

```
ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.    1
Step description:
of Block No.      1  of Schedule No.   12755
Crack Size      c =  0.129197
  13000        1               0.139952               24.192382

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No.    1
Step description:
of Block No.      1  of Schedule No.   13224
Crack Size      c =  0.153810


                   FATIGUE CRACK GROWTH ANALYSIS
                   -------Modified by FAI-------
                 DATE: 23-MAR-99    TIME: 08:40:49
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC2, PSE-F7 CARGO DOOR HINGE TAB-CONTINUING DAMAGE

GEOMETRY
--------
MODEL: TC02-Single edge through crack.

Plate Thickness, t =    0.0630
  "   Width, W     =    0.5000

FLAW SIZE:

c   (init.) =  0.5000E-02



MATERIAL
--------

MATL 1: 2024-T3511
        Extr; L-T; LA & HHA

Material Properties:
```

C-22 PSE F7 SA226 and SA227 Cargo Door Hinge (Continued)

```
:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  77.0:  55.0:  35.0:  25.0: 1.00: 1.00:  0.063:  49.6:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.200D-07:2.700:0.50:1.00:  2.90:  0.70: 1.50: 0.30:

MODEL: TC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    24.000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Total No. of Blocks in Schedule =     1

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From    -    To
   1    -     1                       1

SINGLE DISTINCT BLOCK
 S   : M:  NUMBER     :        S0        :        S1         :
 T   : A:    OF       :                  :                   :
 E   : T:  FATIGUE    :                  :                   :
 P   : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     1.00:    0.00:     1.00:
 S   : M:  NUMBER     :        S2        :        S          :
 T   : A:    OF       :                  :                   :
 E   : T:  FATIGUE    :                  :                   :
 P   : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     1.00:    0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                          -------
 TC2, PSE-F7 CARGO DOOR HING
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
 S   : M:  NUMBER     :        S0        :        S1         :
 T   : A:    OF       :                  :                   :
 E   : T:  FATIGUE    :      (ksi)       :      (ksi)        :
 P   : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:    24.00:    0.00:     0.00:
 S   : M:  NUMBER     :        S2        :        S          :
 T   : A:    OF       :                  :                   :
 E   : T:  FATIGUE    :      (ksi)       :      (ksi)        :
 P   : L:  CYCLES     :   (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     0.00:    0.00:     0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-F7 CARGO DOOR HING
MODEL: TC02

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
500	1		0.005045	3.399873
1000	1		0.005090	3.415273
1500	1		0.005137	3.430833
2000	1		0.005183	3.446557
2500	1		0.005231	3.462447
3000	1		0.005279	3.478506
3500	1		0.005328	3.494737
4000	1		0.005378	3.511142
4500	1		0.005429	3.527725
5000	1		0.005480	3.544488
5500	1		0.005532	3.561434
6000	1		0.005585	3.578567
6500	1		0.005639	3.595889
7000	1		0.005693	3.613405
7500	1		0.005749	3.631116
8000	1		0.005805	3.649027
8500	1		0.005863	3.667141
9000	1		0.005921	3.685462
9500	1		0.005980	3.703992
10000	1		0.006040	3.722737
10500	1		0.006102	3.741700
11000	1		0.006164	3.760884
11500	1		0.006227	3.780293
12000	1		0.006291	3.799932
12500	1		0.006357	3.819806
13000	1		0.006423	3.839917
13500	1		0.006491	3.860271
14000	1		0.006560	3.880872
14500	1		0.006630	3.901725
15000	1		0.006701	3.922834
15500	1		0.006774	3.944205
16000	1		0.006847	3.965842
16500	1		0.006922	3.987751
17000	1		0.006999	4.009936
17500	1		0.007077	4.032404
18000	1		0.007156	4.055159
18500	1		0.007237	4.078207
19000	1		0.007319	4.101555
19500	1		0.007403	4.125208
20000	1		0.007488	4.149173
20500	1		0.007575	4.173455
21000	1		0.007664	4.198062
21500	1		0.007754	4.223000
22000	1		0.007846	4.248276
22500	1		0.007940	4.273897
23000	1		0.008035	4.299870
23500	1		0.008133	4.326203
24000	1		0.008232	4.352904
24500	1		0.008334	4.379980
25000	1		0.008437	4.407440

MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
25500	1		0.008543	4.435293
26000	1		0.008651	4.463546
26500	1		0.008761	4.492210
27000	1		0.008873	4.521292
27500	1		0.008987	4.550804
28000	1		0.009104	4.580754
28500	1		0.009224	4.611154
29000	1		0.009346	4.642012
29500	1		0.009471	4.673341
30000	1		0.009598	4.705152
30500	1		0.009728	4.737455
31000	1		0.009861	4.770263
31500	1		0.009997	4.803589
32000	1		0.010137	4.837445
32500	1		0.010279	4.871845
33000	1		0.010424	4.906802
33500	1		0.010573	4.942330
34000	1		0.010726	4.978444
34500	1		0.010882	5.015160
35000	1		0.011041	5.052493
35500	1		0.011205	5.090459
36000	1		0.011372	5.129077
36500	1		0.011543	5.168362
37000	1		0.011719	5.208334
37500	1		0.011899	5.249012
38000	1		0.012084	5.290415
38500	1		0.012273	5.332564
39000	1		0.012467	5.375481
39500	1		0.012666	5.419188
40000	1		0.012870	5.463708
40500	1		0.013080	5.509065
41000	1		0.013295	5.555285
41500	1		0.013516	5.602394
42000	1		0.013743	5.650419
42500	1		0.013976	5.699390
43000	1		0.014216	5.749336
43500	1		0.014462	5.800289
44000	1		0.014715	5.852282
44500	1		0.014976	5.905349
45000	1		0.015244	5.959526
45500	1		0.015520	6.014852
46000	1		0.015804	6.071366
46500	1		0.016096	6.129110
47000	1		0.016398	6.188128
47500	1		0.016709	6.248467
48000	1		0.017029	6.310175
48500	1		0.017359	6.373303
49000	1		0.017700	6.437906
49500	1		0.018053	6.504042
50000	1		0.018416	6.571771

MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
50500	1		0.018792	6.641157
51000	1		0.019180	6.712269
51500	1		0.019581	6.785179
52000	1		0.019997	6.859963
52500	1		0.020427	6.936704
53000	1		0.020872	7.015490
53500	1		0.021333	7.096412

C-22 PSE F7 SA226 and SA227 Cargo Door Hinge (Continued)

54000	1	0.021812	7.179570
54500	1	0.022308	7.265071
55000	1	0.022823	7.353029
55500	1	0.023358	7.443567
56000	1	0.023914	7.536815
56500	1	0.024492	7.632917
57000	1	0.025093	7.732026
57500	1	0.025720	7.834308
58000	1	0.026373	7.939943
58500	1	0.027054	8.049128
59000	1	0.027765	8.162074
59500	1	0.028508	8.279017
60000	1	0.029285	8.400212
60500	1	0.030098	8.525940
61000	1	0.030951	8.656510
61500	1	0.031845	8.792265
62000	1	0.032784	8.933586
62500	1	0.033772	9.080897
63000	1	0.034812	9.234672
63500	1	0.035909	9.395444
64000	1	0.037068	9.563816
64500	1	0.038293	9.740469
65000	1	0.039592	9.926184
65500	1	0.040972	10.121855
66000	1	0.042440	10.328516
66500	1	0.044005	10.547370
67000	1	0.045679	10.779830
67500	1	0.047475	11.027565
68000	1	0.049406	11.292572
68500	1	0.051491	11.577261
69000	1	0.053751	11.884579
69500	1	0.056212	12.218182
70000	1	0.058906	12.582674
70500	1	0.061872	12.983960
71000	1	0.065163	13.429785
71500	1	0.068846	13.930565
72000	1	0.073011	14.500752
72500	1	0.077785	15.161183
73000	1	0.083354	15.943405
73500	1	0.090006	16.898350
74000	1	0.098221	18.115905
74500	1	0.108918	19.777198

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No. 1
Step description:
of Block No. 1 of Schedule No. 74976
Crack Size c = 0.123285

75000	1	0.124228	22.338612

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No. 1
Step description:
of Block No. 1 of Schedule No. 75454
Crack Size c = 0.148156

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    -------Modified by FAI-------
                  DATE: 16-OCT-97   TIME: 08:36:45
         (computed: NASA/FLAGRO Version 2.03, March 1995.)
         U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC2, PSE-F10 crack in .040 thk cargo Door corner

GEOMETRY
--------
MODEL: TC02-Single edge through crack.

Plate Thickness, t =    0.0400
  "   Width, W     =    0.5000

FLAW SIZE:

c   (init.) =  0.5000E-01



MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; T-L; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  65.0:  48.0:  41.0:  29.0: 1.00: 1.00:  0.040:  57.9:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.244D-07:2.601:0.50:1.00:  2.90:  0.70: 1.50: 0.30:

MODEL: TC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    7.7000
Scale Factor for Stress S1:    0.0000
Scale Factor for Stress S2:    0.0000

Total No. of Blocks in Schedule =     1

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From    -   To
    1   -      1                        1
```

```
SINGLE DISTINCT BLOCK
 S  : M:  NUMBER      :       S0          :        S1          :
 T  : A:    OF        :                   :                    :
 E  : T:  FATIGUE     :                   :                    :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     1.00:     0.00:     1.00:
 S  : M:  NUMBER      :       S2          :        S           :
 T  : A:    OF        :                   :                    :
 E  : T:  FATIGUE     :                   :                    :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     1.00:     0.00:     0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-F10 crack in .040
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

```
STD
 S  : M:  NUMBER      :       S0          :        S1          :
 T  : A:    OF        :                   :                    :
 E  : T:  FATIGUE     :      (ksi)        :       (ksi)        :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     7.70:     0.00:     0.00:
 S  : M:  NUMBER      :       S2          :        S           :
 T  : A:    OF        :                   :                    :
 E  : T:  FATIGUE     :      (ksi)        :       (ksi)        :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     0.00:     0.00:     0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-F10 crack in .040
MODEL: TC02

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
2000	1		0.050198	3.657693
4000	1		0.050399	3.666474
6000	1		0.050601	3.675340
8000	1		0.050806	3.684291
10000	1		0.051012	3.693329
12000	1		0.051221	3.702456
14000	1		0.051432	3.711672
16000	1		0.051645	3.720980
18000	1		0.051860	3.730379
20000	1		0.052077	3.739873
22000	1		0.052297	3.749462
24000	1		0.052519	3.759147
26000	1		0.052743	3.768931
28000	1		0.052970	3.778815
30000	1		0.053199	3.788799
32000	1		0.053430	3.798887
34000	1		0.053664	3.809080
36000	1		0.053901	3.819379
38000	1		0.054140	3.829786
40000	1		0.054382	3.840303

C-23 PSE F10 SA226 and SA227 Cargo Door Opening Corners (Continued)

42000	1	0.054626	3.850932
44000	1	0.054873	3.861674
46000	1	0.055123	3.872532
48000	1	0.055375	3.883508
50000	1	0.055630	3.894603
52000	1	0.055888	3.905820
54000	1	0.056149	3.917160
56000	1	0.056413	3.928627
58000	1	0.056680	3.940222
60000	1	0.056950	3.951948
62000	1	0.057223	3.963806
64000	1	0.057500	3.975800
66000	1	0.057779	3.987932
68000	1	0.058062	4.000204
70000	1	0.058348	4.012620
72000	1	0.058638	4.025182
74000	1	0.058931	4.037892
76000	1	0.059227	4.050754
78000	1	0.059527	4.063771
80000	1	0.059831	4.076945
82000	1	0.060138	4.090281
84000	1	0.060449	4.103780
86000	1	0.060764	4.117447
88000	1	0.061083	4.131285
90000	1	0.061406	4.145298
92000	1	0.061733	4.159488
94000	1	0.062064	4.173861
96000	1	0.062399	4.188420
98000	1	0.062739	4.203169
100000	1	0.063083	4.218112

MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block Step	Final Flaw Size c	K max c-tip
102000	1	0.063431	4.233253
104000	1	0.063784	4.248598
106000	1	0.064142	4.264150
108000	1	0.064504	4.279914
110000	1	0.064872	4.295896
112000	1	0.065244	4.312100
114000	1	0.065621	4.328532
116000	1	0.066004	4.345197
118000	1	0.066392	4.362100
120000	1	0.066785	4.379249
122000	1	0.067184	4.396648
124000	1	0.067589	4.414304
126000	1	0.067999	4.432224
128000	1	0.068415	4.450414
130000	1	0.068838	4.468881
132000	1	0.069266	4.487634
134000	1	0.069701	4.506679
136000	1	0.070143	4.526024
138000	1	0.070591	4.545678
140000	1	0.071045	4.565649
142000	1	0.071507	4.585946
144000	1	0.071976	4.606578
146000	1	0.072453	4.627555
148000	1	0.072937	4.648888
150000	1	0.073429	4.670586
152000	1	0.073928	4.692661
154000	1	0.074436	4.715124
156000	1	0.074952	4.737988
158000	1	0.075477	4.761264
160000	1	0.076011	4.784966

C-23 PSE F10 SA226 and SA227 Cargo Door Opening Corners (Continued)

162000	1	0.076554	4.809108
164000	1	0.077106	4.833705
166000	1	0.077668	4.858770
168000	1	0.078240	4.884321
170000	1	0.078822	4.910374
172000	1	0.079415	4.936946
174000	1	0.080018	4.964055
176000	1	0.080633	4.991722
178000	1	0.081259	5.019967
180000	1	0.081897	5.048811
182000	1	0.082548	5.078277
184000	1	0.083211	5.108388
186000	1	0.083887	5.139171
188000	1	0.084577	5.170652
190000	1	0.085282	5.202859
192000	1	0.086000	5.235823
194000	1	0.086734	5.269575
196000	1	0.087484	5.304150
198000	1	0.088250	5.339583
200000	1	0.089033	5.375913

MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
202000	1		0.089833	5.413181
204000	1		0.090652	5.451430
206000	1		0.091490	5.490707
208000	1		0.092347	5.531063
210000	1		0.093226	5.572551
212000	1		0.094126	5.615227
214000	1		0.095048	5.659155
216000	1		0.095994	5.704401
218000	1		0.096965	5.751036
220000	1		0.097961	5.799138
222000	1		0.098984	5.848791
224000	1		0.100036	5.900086
226000	1		0.101118	5.953122
228000	1		0.102231	6.008007
230000	1		0.103378	6.064859
232000	1		0.104559	6.123806
234000	1		0.105778	6.184989
236000	1		0.107035	6.248564
238000	1		0.108334	6.314702
240000	1		0.109677	6.383594
242000	1		0.111068	6.455448
244000	1		0.112508	6.530501
246000	1		0.114002	6.609013
248000	1		0.115553	6.691279
250000	1		0.117166	6.777630
252000	1		0.118846	6.868442
254000	1		0.120597	6.964140
256000	1		0.122426	7.065213
258000	1		0.124340	7.172221
260000	1		0.126346	7.285814
262000	1		0.128453	7.406747
264000	1		0.130672	7.535909
266000	1		0.133014	7.674349
268000	1		0.135494	7.823321
270000	1		0.138128	7.984339
272000	1		0.140935	8.159249
274000	1		0.143939	8.350334
276000	1		0.147169	8.560456
278000	1		0.150662	8.793270
280000	1		0.154463	9.053530

C-23 PSE F10 SA226 and SA227 Cargo Door Opening Corners (Continued)

282000	1	0.158630	9.347568
284000	1	0.163242	9.684058
286000	1	0.168403	10.075285
288000	1	0.174264	10.539410
290000	1	0.181048	11.104772
292000	1	0.189104	11.818919
294000	1	0.199042	12.770219
296000	1	0.212072	14.150698
298000	1	0.231250	16.510851

ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No. 1
Step description:
of Block No. 1 of Schedule No. 299031
Crack Size c = 0.246566

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No. 1
Step description:
of Block No. 1 of Schedule No. 299771
Crack Size c = 0.263425

C-24 PSE F1 T-Stringer, Top Centerline Near FS 330

FATIGUE CRACK GROWTH ANALYSIS

DATE: 09/16/98 TIME: 12:32:21
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

PSE F-1, 2024 SKIN @ BL 0.0

GEOMETRY

MODEL: TC05-Through crack from hole in row of holes.

```
Plate Thickness, t =    0.0400
Hole Dia., D       =    0.1300
Hole-to-Hole Dist., H      =    0.7500
Dia./Edge-Dist. Ratio, D/B =    0.5000
(D/B = 0 means B is very large)
```

FLAW SIZE:

c (init.) = 0.5000E-01

MATERIAL

MATL 1: 2024-T3
Clad Plt & Sht; L-T; LA & HHA

Material Properties:

Matl No.	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	66.0	53.0	46.0	33.0	1.00	1.00	0.040	65.9	

Matl	Crack Growth Eqn Constants							
No.	C	n	p	q	DKo	Rcl	Alpha	Smax/SIGo
1	0.829E-08	3.284	0.50	1.00	2.90	0.70	1.50	0.30

PSE F-1, 2024 SKIN @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK INPUT TABLE

PRESSURE CYCLE

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

```
Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    33.300
Scale Factor for Stress S4:    3.5000
```

```
Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    33.300
Scale Factor for Stress S4:    1.3000

Stress Scaling Factors for Block Case:  3

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    33.300
Scale Factor for Stress S4:    1.3000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    33.300
Scale Factor for Stress S4:    1.3000

Total No. of Blocks in Schedule =    10

   Block Number and Case Correspondences
 Block Number                 Block Case No.
From    -    To
    1   -     5                       1
    6   -     6                       2
    7   -     9                       3
   10   -    10                       4

BLOCK CASE NO.  1
 S   : M:  NUMBER      :        S0         :        S3         :
 T   : A:    OF        :                   :                   :
 E   : T:  FATIGUE     :                   :                   :
 P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     1.00:     0.00:     1.00:
 S   : M:  NUMBER      :        S4         :        S          :
 T   : A:    OF        :                   :                   :
 E   : T:  FATIGUE     :                   :                   :
 P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :    0.00:     1.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S   : M:  NUMBER      :        S0         :        S3         :
 T   : A:    OF        :                   :                   :
 E   : T:  FATIGUE     :                   :                   :
 P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :   -0.30:     0.30:    -0.30:     0.30:
   2: 1:         1.14 :   -0.50:     0.50:    -0.50:     0.50:
   3: 1:         0.57 :   -0.60:     0.60:    -0.60:     0.60:
   4: 1:         0.11 :   -0.80:     0.80:    -0.80:     0.80:
   5: 1:         0.02 :   -1.00:     1.00:    -1.00:     1.00:
   6: 1:         0.01 :   -1.20:     1.20:    -1.20:     1.20:
   7: 1:         0.00 :   -1.40:     1.40:    -1.40:     1.40:
   8: 1:         0.00 :   -1.60:     1.60:    -1.60:     1.60:
   9: 1:         0.00 :   -1.80:     1.80:    -1.80:     1.80:
  10: 1:         0.00 :   -2.00:     2.00:    -2.00:     2.00:
 S   : M:  NUMBER      :        S4         :        S          :
 T   : A:    OF        :                   :                   :
 E   : T:  FATIGUE     :                   :                   :
 P   : L:  CYCLES      :   (t1) :  (t2)    :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :    2.43:     3.03:     0.00:     0.00:
```

2	1	1.14	2.23	3.23	0.00	0.00
3	1	0.57	2.13	3.33	0.00	0.00
4	1	0.11	1.93	3.53	0.00	0.00
5	1	0.02	1.73	3.73	0.00	0.00
6	1	0.01	1.53	3.93	0.00	0.00
7	1	0.00	1.33	4.13	0.00	0.00
8	1	0.00	1.13	4.33	0.00	0.00
9	1	0.00	0.93	4.53	0.00	0.00
10	1	0.00	0.73	4.73	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	-0.30	0.30	-0.30	0.30
2	1	2.29	-0.50	0.50	-0.50	0.50
3	1	1.14	-0.60	0.60	-0.60	0.60
4	1	0.23	-0.80	0.80	-0.80	0.80
5	1	0.04	-1.00	1.00	-1.00	1.00
6	1	0.01	-1.20	1.20	-1.20	1.20
7	1	0.00	-1.40	1.40	-1.40	1.40
8	1	0.00	-1.60	1.60	-1.60	1.60
9	1	0.00	-1.80	1.80	-1.80	1.80
10	1	0.00	-2.00	2.00	-2.00	2.00

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	19.14	2.43	3.03	0.00	0.00
2	1	2.29	2.23	3.23	0.00	0.00
3	1	1.14	2.13	3.33	0.00	0.00
4	1	0.23	1.93	3.53	0.00	0.00
5	1	0.04	1.73	3.73	0.00	0.00
6	1	0.01	1.53	3.93	0.00	0.00
7	1	0.00	1.33	4.13	0.00	0.00
8	1	0.00	1.13	4.33	0.00	0.00
9	1	0.00	0.93	4.53	0.00	0.00
10	1	0.00	0.73	4.73	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT L	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	-0.30	0.30	-0.30	0.30
2	1	4.57	-0.50	0.50	-0.50	0.50
3	1	2.29	-0.60	0.60	-0.60	0.60
4	1	0.46	-0.80	0.80	-0.80	0.80
5	1	0.08	-1.00	1.00	-1.00	1.00
6	1	0.02	-1.20	1.20	-1.20	1.20
7	1	0.01	-1.40	1.40	-1.40	1.40
8	1	0.00	-1.60	1.60	-1.60	1.60
9	1	0.00	-1.80	1.80	-1.80	1.80
10	1	0.00	-2.00	2.00	-2.00	2.00

S T E	M A T	NUMBER OF FATIGUE	S4	S

P	L:	CYCLES :	(t1) :	(t2) :	(t1) :	(t2) :
1:	1:	38.29 :	2.43:	3.03:	0.00:	0.00:
2:	1:	4.57 :	2.23:	3.23:	0.00:	0.00:
3:	1:	2.29 :	2.13:	3.33:	0.00:	0.00:
4:	1:	0.46 :	1.93:	3.53:	0.00:	0.00:
5:	1:	0.08 :	1.73:	3.73:	0.00:	0.00:
6:	1:	0.02 :	1.53:	3.93:	0.00:	0.00:
7:	1:	0.01 :	1.33:	4.13:	0.00:	0.00:
8:	1:	0.00 :	1.13:	4.33:	0.00:	0.00:
9:	1:	0.00 :	0.93:	4.53:	0.00:	0.00:
10:	1:	0.00 :	0.73:	4.73:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, 2024 SKIN @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

PRESSURE CYCLE

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	1.00 :	0.00:	0.00:	0.00:	33.30:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	1.00 :	0.00:	3.50:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, 2024 SKIN @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

PRESSURE CYCLE

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1:	1:	9.57 :	0.00:	0.00:	-9.99:	9.99:
2:	1:	1.14 :	0.00:	0.00:	-16.65:	16.65:
3:	1:	0.57 :	0.00:	0.00:	-19.98:	19.98:
4:	1:	0.11 :	0.00:	0.00:	-26.64:	26.64:
5:	1:	0.02 :	0.00:	0.00:	-33.30:	33.30:
6:	1:	0.01 :	0.00:	0.00:	-39.96:	39.96:
7:	1:	0.00 :	0.00:	0.00:	-46.62:	46.62:
8:	1:	0.00 :	0.00:	0.00:	-53.28:	53.28:
9:	1:	0.00 :	0.00:	0.00:	-59.94:	59.94:
10:	1:	0.00 :	0.00:	0.00:	-66.60:	66.60:

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1:	1:	9.57 :	3.16:	3.94:	0.00:	0.00:
2:	1:	1.14 :	2.90:	4.20:	0.00:	0.00:
3:	1:	0.57 :	2.77:	4.33:	0.00:	0.00:
4:	1:	0.11 :	2.51:	4.59:	0.00:	0.00:
5:	1:	0.02 :	2.25:	4.85:	0.00:	0.00:

```
   6: 1:         0.01 :     1.99:     5.11:     0.00:     0.00:
   7: 1:         0.00 :     1.73:     5.37:     0.00:     0.00:
   8: 1:         0.00 :     1.47:     5.63:     0.00:     0.00:
   9: 1:         0.00 :     1.21:     5.89:     0.00:     0.00:
  10: 1:         0.00 :     0.95:     6.15:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                          -------
 PSE F-1, 2024 SKIN @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE
----------------------------------
PRESSURE CYCLE
 S  : M:  NUMBER      :         S0          :          S3         :
 T  : A:    OF        :                     :                     :
 E  : T:  FATIGUE     :       (ksi)         :        (ksi)        :
 P  : L:  CYCLES      :    (t1) :  (t2)     :     (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        19.14 :     0.00:     0.00:    -9.99:     9.99:
   2: 1:         2.29 :     0.00:     0.00:   -16.65:    16.65:
   3: 1:         1.14 :     0.00:     0.00:   -19.98:    19.98:
   4: 1:         0.23 :     0.00:     0.00:   -26.64:    26.64:
   5: 1:         0.04 :     0.00:     0.00:   -33.30:    33.30:
   6: 1:         0.01 :     0.00:     0.00:   -39.96:    39.96:
   7: 1:         0.00 :     0.00:     0.00:   -46.62:    46.62:
   8: 1:         0.00 :     0.00:     0.00:   -53.28:    53.28:
   9: 1:         0.00 :     0.00:     0.00:   -59.94:    59.94:
  10: 1:         0.00 :     0.00:     0.00:   -66.60:    66.60:
 S  : M:  NUMBER      :         S4          :          S          :
 T  : A:    OF        :                     :                     :
 E  : T:  FATIGUE     :       (ksi)         :        (ksi)        :
 P  : L:  CYCLES      :    (t1) :  (t2)     :     (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        19.14 :     3.16:     3.94:     0.00:     0.00:
   2: 1:         2.29 :     2.90:     4.20:     0.00:     0.00:
   3: 1:         1.14 :     2.77:     4.33:     0.00:     0.00:
   4: 1:         0.23 :     2.51:     4.59:     0.00:     0.00:
   5: 1:         0.04 :     2.25:     4.85:     0.00:     0.00:
   6: 1:         0.01 :     1.99:     5.11:     0.00:     0.00:
   7: 1:         0.00 :     1.73:     5.37:     0.00:     0.00:
   8: 1:         0.00 :     1.47:     5.63:     0.00:     0.00:
   9: 1:         0.00 :     1.21:     5.89:     0.00:     0.00:
  10: 1:         0.00 :     0.95:     6.15:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                          -------
 PSE F-1, 2024 SKIN @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE
----------------------------------
PRESSURE CYCLE
 S  : M:  NUMBER      :         S0          :          S3         :
 T  : A:    OF        :                     :                     :
 E  : T:  FATIGUE     :       (ksi)         :        (ksi)        :
 P  : L:  CYCLES      :    (t1) :  (t2)     :     (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        38.29 :     0.00:     0.00:    -9.99:     9.99:
   2: 1:         4.57 :     0.00:     0.00:   -16.65:    16.65:
   3: 1:         2.29 :     0.00:     0.00:   -19.98:    19.98:
   4: 1:         0.46 :     0.00:     0.00:   -26.64:    26.64:
   5: 1:         0.08 :     0.00:     0.00:   -33.30:    33.30:
   6: 1:         0.02 :     0.00:     0.00:   -39.96:    39.96:
   7: 1:         0.01 :     0.00:     0.00:   -46.62:    46.62:
   8: 1:         0.00 :     0.00:     0.00:   -53.28:    53.28:
   9: 1:         0.00 :     0.00:     0.00:   -59.94:    59.94:
```

```
 10: 1:        0.00 :    0.00:     0.00:   -66.60:    66.60:
S  : M:  NUMBER     :     S4          :       S           :
T  : A:    OF       :                 :                   :
E  : T:  FATIGUE    :    (ksi)        :      (ksi)        :
P  : L:  CYCLES     :  (t1) :  (t2)   :   (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
  1: 1:       38.29 :    3.16:     3.94:     0.00:     0.00:
  2: 1:        4.57 :    2.90:     4.20:     0.00:     0.00:
  3: 1:        2.29 :    2.77:     4.33:     0.00:     0.00:
  4: 1:        0.46 :    2.51:     4.59:     0.00:     0.00:
  5: 1:        0.08 :    2.25:     4.85:     0.00:     0.00:
  6: 1:        0.02 :    1.99:     5.11:     0.00:     0.00:
  7: 1:        0.01 :    1.73:     5.37:     0.00:     0.00:
  8: 1:        0.00 :    1.47:     5.63:     0.00:     0.00:
  9: 1:        0.00 :    1.21:     5.89:     0.00:     0.00:
 10: 1:        0.00 :    0.95:     6.15:     0.00:     0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, 2024 SKIN @ BL 0.0
MODEL: TC05

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
2000	6		0.052141	9.469770
4000	6		0.054229	9.417244
6000	6		0.056271	9.365817
8000	6		0.058267	9.316102
10000	6		0.060221	9.268527
12000	6		0.062134	9.223380
14000	6		0.064009	9.180830
16000	6		0.065850	9.140933
18000	6		0.067658	9.103676
20000	6		0.069436	9.069002
22000	6		0.071187	9.036820
24000	6		0.072913	9.007014
26000	6		0.074615	8.979447
28000	6		0.076297	8.953968
30000	6		0.077959	8.930415
32000	6		0.079603	8.908616
34000	6		0.081231	8.888389
36000	6		0.082843	8.869549
38000	6		0.084441	8.851902
40000	6		0.086027	8.835250
42000	6		0.087599	8.819388
44000	6		0.089160	8.804111
46000	6		0.090710	8.789204
48000	6		0.092248	8.774452
50000	6		0.093776	8.759644
52000	6		0.095292	8.744696
54000	6		0.096796	8.729649
56000	6		0.098290	8.714543
58000	6		0.099773	8.699416
60000	6		0.101244	8.684297
62000	6		0.102704	8.669215
64000	6		0.104153	8.654193
66000	6		0.105591	8.639250
68000	6		0.107019	8.624404
70000	6		0.108436	8.609668

FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No. 0.00 of Load Step No. 10

```
Step description:
of Block No.     10  of Schedule No.   70000
Crack Size      c =  0.108436


                  FATIGUE CRACK GROWTH ANALYSIS
                  -----------------------------
                DATE: 09/16/98     TIME: 12:38:19
       (computed: NASA/FLAGRO Version 2.03, March 1995.)
       U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
PSE F-1, ORIG ALUM STRINGER @ BL 0.0

GEOMETRY
--------
MODEL: TC05-Through crack from hole in row of holes.

Plate Thickness, t =     0.0500
Hole Dia., D       =     0.1300
Hole-to-Hole Dist., H       =    0.7500
Dia./Edge-Dist. Ratio, D/B =    0.5000
(D/B = 0 means B is very large)

FLAW SIZE:

c   (init.) =  0.5000E-01




MATERIAL
--------

MATL 1: 2014-T651
        Plt & Sht; L-T

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  71.0:  64.0:  28.0:  22.0: 1.00: 1.00:  0.050:  43.4:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.150E-07:2.800:0.50:1.00:  2.70:  0.70: 1.50: 0.30:
 PSE F-1, ORIG ALUM STRINGER @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
PRESSURE CYCLE

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    26.700
Scale Factor for Stress S4:    3.5000

Stress Scaling Factors for Block Case:  2

Scale Factor for Stress S0:   0.00000
```

Scale Factor for Stress S3: 26.700
Scale Factor for Stress S4: 1.3000

Stress Scaling Factors for Block Case: 3

Scale Factor for Stress S0: 0.00000
Scale Factor for Stress S3: 26.700
Scale Factor for Stress S4: 1.3000

Stress Scaling Factors for Block Case: 4

Scale Factor for Stress S0: 0.00000
Scale Factor for Stress S3: 26.700
Scale Factor for Stress S4: 1.3000

Total No. of Blocks in Schedule = 10

Block Number and Case Correspondences

Block Number From	-	To	Block Case No.
1	-	5	1
6	-	6	2
7	-	9	3
10	-	10	4

BLOCK CASE NO. 1

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	1.00	0.00	1.00	0.00	1.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	1.00	0.00	1.00	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 2

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	9.57	-0.30	0.30	-0.30	0.30
2	1	1.14	-0.50	0.50	-0.50	0.50
3	1	0.57	-0.60	0.60	-0.60	0.60
4	1	0.11	-0.80	0.80	-0.80	0.80
5	1	0.02	-1.00	1.00	-1.00	1.00
6	1	0.01	-1.20	1.20	-1.20	1.20
7	1	0.00	-1.40	1.40	-1.40	1.40
8	1	0.00	-1.60	1.60	-1.60	1.60
9	1	0.00	-1.80	1.80	-1.80	1.80
10	1	0.00	-2.00	2.00	-2.00	2.00

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	9.57	2.43	3.03	0.00	0.00
2	1	1.14	2.23	3.23	0.00	0.00
3	1	0.57	2.13	3.33	0.00	0.00
4	1	0.11	1.93	3.53	0.00	0.00
5	1	0.02	1.73	3.73	0.00	0.00

C-24 PSE F1 T-Stringer, Top Centerline Near FS 330 (Continued)

```
  6: 1:         0.01 :    1.53:     3.93:     0.00:     0.00:
  7: 1:         0.00 :    1.33:     4.13:     0.00:     0.00:
  8: 1:         0.00 :    1.13:     4.33:     0.00:     0.00:
  9: 1:         0.00 :    0.93:     4.53:     0.00:     0.00:
 10: 1:         0.00 :    0.73:     4.73:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  3
S   : M:  NUMBER      :        S0          :        S3          :
T   : A:    OF        :                    :                    :
E   : T:  FATIGUE     :                    :                    :
P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        19.14 :   -0.30:     0.30:    -0.30:     0.30:
  2: 1:         2.29 :   -0.50:     0.50:    -0.50:     0.50:
  3: 1:         1.14 :   -0.60:     0.60:    -0.60:     0.60:
  4: 1:         0.23 :   -0.80:     0.80:    -0.80:     0.80:
  5: 1:         0.04 :   -1.00:     1.00:    -1.00:     1.00:
  6: 1:         0.01 :   -1.20:     1.20:    -1.20:     1.20:
  7: 1:         0.00 :   -1.40:     1.40:    -1.40:     1.40:
  8: 1:         0.00 :   -1.60:     1.60:    -1.60:     1.60:
  9: 1:         0.00 :   -1.80:     1.80:    -1.80:     1.80:
 10: 1:         0.00 :   -2.00:     2.00:    -2.00:     2.00:
S   : M:  NUMBER      :        S4          :        S           :
T   : A:    OF        :                    :                    :
E   : T:  FATIGUE     :                    :                    :
P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        19.14 :    2.43:     3.03:     0.00:     0.00:
  2: 1:         2.29 :    2.23:     3.23:     0.00:     0.00:
  3: 1:         1.14 :    2.13:     3.33:     0.00:     0.00:
  4: 1:         0.23 :    1.93:     3.53:     0.00:     0.00:
  5: 1:         0.04 :    1.73:     3.73:     0.00:     0.00:
  6: 1:         0.01 :    1.53:     3.93:     0.00:     0.00:
  7: 1:         0.00 :    1.33:     4.13:     0.00:     0.00:
  8: 1:         0.00 :    1.13:     4.33:     0.00:     0.00:
  9: 1:         0.00 :    0.93:     4.53:     0.00:     0.00:
 10: 1:         0.00 :    0.73:     4.73:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  4
S   : M:  NUMBER      :        S0          :        S3          :
T   : A:    OF        :                    :                    :
E   : T:  FATIGUE     :                    :                    :
P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        38.29 :   -0.30:     0.30:    -0.30:     0.30:
  2: 1:         4.57 :   -0.50:     0.50:    -0.50:     0.50:
  3: 1:         2.29 :   -0.60:     0.60:    -0.60:     0.60:
  4: 1:         0.46 :   -0.80:     0.80:    -0.80:     0.80:
  5: 1:         0.08 :   -1.00:     1.00:    -1.00:     1.00:
  6: 1:         0.02 :   -1.20:     1.20:    -1.20:     1.20:
  7: 1:         0.01 :   -1.40:     1.40:    -1.40:     1.40:
  8: 1:         0.00 :   -1.60:     1.60:    -1.60:     1.60:
  9: 1:         0.00 :   -1.80:     1.80:    -1.80:     1.80:
 10: 1:         0.00 :   -2.00:     2.00:    -2.00:     2.00:
S   : M:  NUMBER      :        S4          :        S           :
T   : A:    OF        :                    :                    :
E   : T:  FATIGUE     :                    :                    :
P   : L:  CYCLES      :   (t1) :  (t2)     :   (t1) :  (t2)     :
----:--:-------------:---------:---------:---------:---------:
  1: 1:        38.29 :    2.43:     3.03:     0.00:     0.00:
  2: 1:         4.57 :    2.23:     3.23:     0.00:     0.00:
```

C-24 PSE F1 T-Stringer, Top Centerline Near FS 330 (Continued)

3	1	2.29	2.13	3.33	0.00	0.00
4	1	0.46	1.93	3.53	0.00	0.00
5	1	0.08	1.73	3.73	0.00	0.00
6	1	0.02	1.53	3.93	0.00	0.00
7	1	0.01	1.33	4.13	0.00	0.00
8	1	0.00	1.13	4.33	0.00	0.00
9	1	0.00	0.93	4.53	0.00	0.00
10	1	0.00	0.73	4.73	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, ORIG ALUM STRINGER @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

PRESSURE CYCLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.00	0.00	0.00	0.00	26.70

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.00	0.00	3.50	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, ORIG ALUM STRINGER @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

PRESSURE CYCLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	0.00	0.00	-8.01	8.01
2	1	1.14	0.00	0.00	-13.35	13.35
3	1	0.57	0.00	0.00	-16.02	16.02
4	1	0.11	0.00	0.00	-21.36	21.36
5	1	0.02	0.00	0.00	-26.70	26.70
6	1	0.01	0.00	0.00	-32.04	32.04
7	1	0.00	0.00	0.00	-37.38	37.38
8	1	0.00	0.00	0.00	-42.72	42.72
9	1	0.00	0.00	0.00	-48.06	48.06
10	1	0.00	0.00	0.00	-53.40	53.40

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	3.16	3.94	0.00	0.00
2	1	1.14	2.90	4.20	0.00	0.00
3	1	0.57	2.77	4.33	0.00	0.00
4	1	0.11	2.51	4.59	0.00	0.00
5	1	0.02	2.25	4.85	0.00	0.00
6	1	0.01	1.99	5.11	0.00	0.00
7	1	0.00	1.73	5.37	0.00	0.00
8	1	0.00	1.47	5.63	0.00	0.00
9	1	0.00	1.21	5.89	0.00	0.00

10	1	0.00	0.95	6.15	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, ORIG ALUM STRINGER @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

PRESSURE CYCLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	0.00	0.00	-8.01	8.01
2	1	2.29	0.00	0.00	-13.35	13.35
3	1	1.14	0.00	0.00	-16.02	16.02
4	1	0.23	0.00	0.00	-21.36	21.36
5	1	0.04	0.00	0.00	-26.70	26.70
6	1	0.01	0.00	0.00	-32.04	32.04
7	1	0.00	0.00	0.00	-37.38	37.38
8	1	0.00	0.00	0.00	-42.72	42.72
9	1	0.00	0.00	0.00	-48.06	48.06
10	1	0.00	0.00	0.00	-53.40	53.40

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	3.16	3.94	0.00	0.00
2	1	2.29	2.90	4.20	0.00	0.00
3	1	1.14	2.77	4.33	0.00	0.00
4	1	0.23	2.51	4.59	0.00	0.00
5	1	0.04	2.25	4.85	0.00	0.00
6	1	0.01	1.99	5.11	0.00	0.00
7	1	0.00	1.73	5.37	0.00	0.00
8	1	0.00	1.47	5.63	0.00	0.00
9	1	0.00	1.21	5.89	0.00	0.00
10	1	0.00	0.95	6.15	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, ORIG ALUM STRINGER @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

PRESSURE CYCLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	0.00	0.00	-8.01	8.01
2	1	4.57	0.00	0.00	-13.35	13.35
3	1	2.29	0.00	0.00	-16.02	16.02
4	1	0.46	0.00	0.00	-21.36	21.36
5	1	0.08	0.00	0.00	-26.70	26.70
6	1	0.02	0.00	0.00	-32.04	32.04
7	1	0.01	0.00	0.00	-37.38	37.38
8	1	0.00	0.00	0.00	-42.72	42.72
9	1	0.00	0.00	0.00	-48.06	48.06
10	1	0.00	0.00	0.00	-53.40	53.40

S	M:	NUMBER	S4		S	
T	A:	OF				
E	T:	FATIGUE	(ksi)		(ksi)	

C-24 PSE F1 T-Stringer, Top Centerline Near FS 330 (Continued)

P	L:	CYCLES	(t1)	(t2)	(t1)	(t2)
1:	1:	38.29	3.16:	3.94:	0.00:	0.00:
2:	1:	4.57	2.90:	4.20:	0.00:	0.00:
3:	1:	2.29	2.77:	4.33:	0.00:	0.00:
4:	1:	0.46	2.51:	4.59:	0.00:	0.00:
5:	1:	0.08	2.25:	4.85:	0.00:	0.00:
6:	1:	0.02	1.99:	5.11:	0.00:	0.00:
7:	1:	0.01	1.73:	5.37:	0.00:	0.00:
8:	1:	0.00	1.47:	5.63:	0.00:	0.00:
9:	1:	0.00	1.21:	5.89:	0.00:	0.00:
10:	1:	0.00	0.95:	6.15:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, ORIG ALUM STRINGER @ BL 0.0
MODEL: TC05

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
2000	6		0.051077	7.563928
4000	6		0.052141	7.544158
6000	6		0.053194	7.524382
8000	6		0.054236	7.504693
10000	6		0.055266	7.485174
12000	6		0.056284	7.465894
14000	6		0.057292	7.446913
16000	6		0.058288	7.428281
18000	6		0.059274	7.410040
20000	6		0.060250	7.392224
22000	6		0.061215	7.374863
24000	6		0.062171	7.357979
26000	6		0.063118	7.341587
28000	6		0.064055	7.325698
30000	6		0.064984	7.310316
32000	6		0.065904	7.295443
34000	6		0.066816	7.281077
36000	6		0.067721	7.267215
38000	6		0.068617	7.253851
40000	6		0.069507	7.240979
42000	6		0.070389	7.228589
44000	6		0.071265	7.216671
46000	6		0.072135	7.205212
48000	6		0.072998	7.194202
50000	6		0.073856	7.183625
52000	6		0.074708	7.173468
54000	6		0.075555	7.163716
56000	6		0.076396	7.154352
58000	6		0.077232	7.145361
60000	6		0.078064	7.136726
62000	6		0.078891	7.128429
64000	6		0.079714	7.120453
66000	6		0.080533	7.112780
68000	6		0.081348	7.105392
70000	6		0.082158	7.098269

FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No. 0.00 of Load Step No. 10
Step description:
of Block No. 10 of Schedule No. 70000
Crack Size c = 0.821583E-01

C-24 PSE F1 T-Stringer, Top Centerline Near FS 330 (Continued)

FATIGUE CRACK GROWTH ANALYSIS

DATE: 09/16/98 TIME: 12:48:17
(computed: NASA/FLAGRO Version 2.03, March 1995.)
U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE

PSE F-1, 7075-T73511 STRINGER @ BL 0.0

GEOMETRY

MODEL: TC05-Through crack from hole in row of holes.

```
Plate Thickness, t =     0.0630
Hole Dia., D       =     0.1300
Hole-to-Hole Dist., H       =     0.7500
Dia./Edge-Dist. Ratio, D/B =     0.5000
(D/B = 0 means B is very large)
```

FLAW SIZE:

c (init.) = 0.5000E-01

MATERIAL

MATL 1: 7075-T73511
Extr; L-T; LA,DA,HHA

Material Properties:

Matl No.	UTS	YS	K1e	K1c	Ak	Bk	Thk	Kc	KIscc
1	74.0	65.0	46.0	33.0	1.00	1.00	0.063	65.7	

Matl No.	C	n	p	q	DKo	Rcl	Alpha	Smax/SIGo
	Crack Growth Eqn Constants							
1	0.347E-07	2.508	0.50	1.00	2.40	0.70	1.90	0.30

PSE F-1, 7075-T73511 STRINGER @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK INPUT TABLE

PRESSURE CYCLE

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case: 1

```
Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    21.200
Scale Factor for Stress S4:    3.5000
```

Stress Scaling Factors for Block Case: 2

```
Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    21.200
Scale Factor for Stress S4:    1.3000
```

Stress Scaling Factors for Block Case: 3

C-24 PSE F1 T-Stringer, Top Centerline Near FS 330 (Continued)

```
Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    21.200
Scale Factor for Stress S4:    1.3000

Stress Scaling Factors for Block Case:  4

Scale Factor for Stress S0:   0.00000
Scale Factor for Stress S3:    21.200
Scale Factor for Stress S4:    1.3000

Total No. of Blocks in Schedule =    10

   Block Number and Case Correspondences
 Block Number                   Block Case No.
From   -   To
    1   -     5                        1
    6   -     6                        2
    7   -     9                        3
   10   -    10                        4

BLOCK CASE NO.  1
 S  : M:  NUMBER     :        S0         :        S3         :
 T  : A:    OF       :                   :                   :
 E  : T:  FATIGUE    :                   :                   :
 P  : L:  CYCLES     :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :     0.00:     1.00:     0.00:     1.00:
 S  : M:  NUMBER     :        S4         :        S          :
 T  : A:    OF       :                   :                   :
 E  : T:  FATIGUE    :                   :                   :
 P  : L:  CYCLES     :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         1.00 :     0.00:     1.00:     0.00:     0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------

BLOCK CASE NO.  2
 S  : M:  NUMBER     :        S0         :        S3         :
 T  : A:    OF       :                   :                   :
 E  : T:  FATIGUE    :                   :                   :
 P  : L:  CYCLES     :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :    -0.30:     0.30:    -0.30:     0.30:
   2: 1:         1.14 :    -0.50:     0.50:    -0.50:     0.50:
   3: 1:         0.57 :    -0.60:     0.60:    -0.60:     0.60:
   4: 1:         0.11 :    -0.80:     0.80:    -0.80:     0.80:
   5: 1:         0.02 :    -1.00:     1.00:    -1.00:     1.00:
   6: 1:         0.01 :    -1.20:     1.20:    -1.20:     1.20:
   7: 1:         0.00 :    -1.40:     1.40:    -1.40:     1.40:
   8: 1:         0.00 :    -1.60:     1.60:    -1.60:     1.60:
   9: 1:         0.00 :    -1.80:     1.80:    -1.80:     1.80:
  10: 1:         0.00 :    -2.00:     2.00:    -2.00:     2.00:
 S  : M:  NUMBER     :        S4         :        S          :
 T  : A:    OF       :                   :                   :
 E  : T:  FATIGUE    :                   :                   :
 P  : L:  CYCLES     :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
   1: 1:         9.57 :     2.43:     3.03:     0.00:     0.00:
   2: 1:         1.14 :     2.23:     3.23:     0.00:     0.00:
   3: 1:         0.57 :     2.13:     3.33:     0.00:     0.00:
   4: 1:         0.11 :     1.93:     3.53:     0.00:     0.00:
   5: 1:         0.02 :     1.73:     3.73:     0.00:     0.00:
   6: 1:         0.01 :     1.53:     3.93:     0.00:     0.00:
   7: 1:         0.00 :     1.33:     4.13:     0.00:     0.00:
   8: 1:         0.00 :     1.13:     4.33:     0.00:     0.00:
   9: 1:         0.00 :     0.93:     4.53:     0.00:     0.00:
```

C-24 PSE F1 T-Stringer, Top Centerline Near FS 330 (Continued)

10	1	0.00	0.73	4.73	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 3

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	19.14	-0.30	0.30	-0.30	0.30
2	1	2.29	-0.50	0.50	-0.50	0.50
3	1	1.14	-0.60	0.60	-0.60	0.60
4	1	0.23	-0.80	0.80	-0.80	0.80
5	1	0.04	-1.00	1.00	-1.00	1.00
6	1	0.01	-1.20	1.20	-1.20	1.20
7	1	0.00	-1.40	1.40	-1.40	1.40
8	1	0.00	-1.60	1.60	-1.60	1.60
9	1	0.00	-1.80	1.80	-1.80	1.80
10	1	0.00	-2.00	2.00	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	19.14	2.43	3.03	0.00	0.00
2	1	2.29	2.23	3.23	0.00	0.00
3	1	1.14	2.13	3.33	0.00	0.00
4	1	0.23	1.93	3.53	0.00	0.00
5	1	0.04	1.73	3.73	0.00	0.00
6	1	0.01	1.53	3.93	0.00	0.00
7	1	0.00	1.33	4.13	0.00	0.00
8	1	0.00	1.13	4.33	0.00	0.00
9	1	0.00	0.93	4.53	0.00	0.00
10	1	0.00	0.73	4.73	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

BLOCK CASE NO. 4

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (t1)	S0 (t2)	S3 (t1)	S3 (t2)
1	1	38.29	-0.30	0.30	-0.30	0.30
2	1	4.57	-0.50	0.50	-0.50	0.50
3	1	2.29	-0.60	0.60	-0.60	0.60
4	1	0.46	-0.80	0.80	-0.80	0.80
5	1	0.08	-1.00	1.00	-1.00	1.00
6	1	0.02	-1.20	1.20	-1.20	1.20
7	1	0.01	-1.40	1.40	-1.40	1.40
8	1	0.00	-1.60	1.60	-1.60	1.60
9	1	0.00	-1.80	1.80	-1.80	1.80
10	1	0.00	-2.00	2.00	-2.00	2.00

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (t1)	S4 (t2)	S (t1)	S (t2)
1	1	38.29	2.43	3.03	0.00	0.00
2	1	4.57	2.23	3.23	0.00	0.00
3	1	2.29	2.13	3.33	0.00	0.00
4	1	0.46	1.93	3.53	0.00	0.00
5	1	0.08	1.73	3.73	0.00	0.00
6	1	0.02	1.53	3.93	0.00	0.00

7	1	0.01	1.33	4.13	0.00	0.00
8	1	0.00	1.13	4.33	0.00	0.00
9	1	0.00	0.93	4.53	0.00	0.00
10	1	0.00	0.73	4.73	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, 7075-T73511 STRINGER @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

PRESSURE CYCLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	1.00	0.00	0.00	0.00	21.20

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	1.00	0.00	3.50	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, 7075-T73511 STRINGER @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

PRESSURE CYCLE

STEP	MAT	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	9.57	0.00	0.00	-6.36	6.36
2	1	1.14	0.00	0.00	-10.60	10.60
3	1	0.57	0.00	0.00	-12.72	12.72
4	1	0.11	0.00	0.00	-16.96	16.96
5	1	0.02	0.00	0.00	-21.20	21.20
6	1	0.01	0.00	0.00	-25.44	25.44
7	1	0.00	0.00	0.00	-29.68	29.68
8	1	0.00	0.00	0.00	-33.92	33.92
9	1	0.00	0.00	0.00	-38.16	38.16
10	1	0.00	0.00	0.00	-42.40	42.40

STEP	MAT	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	9.57	3.16	3.94	0.00	0.00
2	1	1.14	2.90	4.20	0.00	0.00
3	1	0.57	2.77	4.33	0.00	0.00
4	1	0.11	2.51	4.59	0.00	0.00
5	1	0.02	2.25	4.85	0.00	0.00
6	1	0.01	1.99	5.11	0.00	0.00
7	1	0.00	1.73	5.37	0.00	0.00
8	1	0.00	1.47	5.63	0.00	0.00
9	1	0.00	1.21	5.89	0.00	0.00
10	1	0.00	0.95	6.15	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

C-24 PSE F1 T-Stringer, Top Centerline Near FS 330 (Continued)

PSE F-1, 7075-T73511 STRINGER @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

PRESSURE CYCLE

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	19.14	0.00	0.00	-6.36	6.36
2	1	2.29	0.00	0.00	-10.60	10.60
3	1	1.14	0.00	0.00	-12.72	12.72
4	1	0.23	0.00	0.00	-16.96	16.96
5	1	0.04	0.00	0.00	-21.20	21.20
6	1	0.01	0.00	0.00	-25.44	25.44
7	1	0.00	0.00	0.00	-29.68	29.68
8	1	0.00	0.00	0.00	-33.92	33.92
9	1	0.00	0.00	0.00	-38.16	38.16
10	1	0.00	0.00	0.00	-42.40	42.40

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	19.14	3.16	3.94	0.00	0.00
2	1	2.29	2.90	4.20	0.00	0.00
3	1	1.14	2.77	4.33	0.00	0.00
4	1	0.23	2.51	4.59	0.00	0.00
5	1	0.04	2.25	4.85	0.00	0.00
6	1	0.01	1.99	5.11	0.00	0.00
7	1	0.00	1.73	5.37	0.00	0.00
8	1	0.00	1.47	5.63	0.00	0.00
9	1	0.00	1.21	5.89	0.00	0.00
10	1	0.00	0.95	6.15	0.00	0.00

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, 7075-T73511 STRINGER @ BL 0.0
MODEL: TC05

FATIGUE SCHEDULE BLOCK STRESS TABLE

PRESSURE CYCLE

STEP	MATL	NUMBER OF FATIGUE CYCLES	S0 (ksi) (t1)	S0 (ksi) (t2)	S3 (ksi) (t1)	S3 (ksi) (t2)
1	1	38.29	0.00	0.00	-6.36	6.36
2	1	4.57	0.00	0.00	-10.60	10.60
3	1	2.29	0.00	0.00	-12.72	12.72
4	1	0.46	0.00	0.00	-16.96	16.96
5	1	0.08	0.00	0.00	-21.20	21.20
6	1	0.02	0.00	0.00	-25.44	25.44
7	1	0.01	0.00	0.00	-29.68	29.68
8	1	0.00	0.00	0.00	-33.92	33.92
9	1	0.00	0.00	0.00	-38.16	38.16
10	1	0.00	0.00	0.00	-42.40	42.40

STEP	MATL	NUMBER OF FATIGUE CYCLES	S4 (ksi) (t1)	S4 (ksi) (t2)	S (ksi) (t1)	S (ksi) (t2)
1	1	38.29	3.16	3.94	0.00	0.00
2	1	4.57	2.90	4.20	0.00	0.00

C-24 PSE F1 T-Stringer, Top Centerline Near FS 330 (Continued)

3:	1:	2.29 :	2.77:	4.33:	0.00:	0.00:
4:	1:	0.46 :	2.51:	4.59:	0.00:	0.00:
5:	1:	0.08 :	2.25:	4.85:	0.00:	0.00:
6:	1:	0.02 :	1.99:	5.11:	0.00:	0.00:
7:	1:	0.01 :	1.73:	5.37:	0.00:	0.00:
8:	1:	0.00 :	1.47:	5.63:	0.00:	0.00:
9:	1:	0.00 :	1.21:	5.89:	0.00:	0.00:
10:	1:	0.00 :	0.95:	6.15:	0.00:	0.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

PSE F-1, 7075-T73511 STRINGER @ BL 0.0
MODEL: TC05

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
2000	6		0.051034	5.954231
4000	6		0.052055	5.940656
6000	6		0.053061	5.927069
8000	6		0.054052	5.913553
10000	6		0.055024	5.900222
12000	6		0.055981	5.887067
14000	6		0.056929	5.874067
16000	6		0.057866	5.861258
18000	6		0.058795	5.848672
20000	6		0.059714	5.836336
22000	6		0.060625	5.824272
24000	6		0.061527	5.812499
26000	6		0.062420	5.801032
28000	6		0.063305	5.789882
30000	6		0.064182	5.779055
32000	6		0.065051	5.768556
34000	6		0.065913	5.758387
36000	6		0.066768	5.748547
38000	6		0.067616	5.739036
40000	6		0.068457	5.729851
42000	6		0.069291	5.720989
44000	6		0.070119	5.712444
46000	6		0.070942	5.704211
48000	6		0.071758	5.696283
50000	6		0.072569	5.688653
52000	6		0.073375	5.681313
54000	6		0.074176	5.674255
56000	6		0.074971	5.667470
58000	6		0.075762	5.660948
60000	6		0.076549	5.654679
62000	6		0.077331	5.648654
64000	6		0.078108	5.642861
66000	6		0.078882	5.637290
68000	6		0.079652	5.631930
70000	6		0.080418	5.626769

FINAL RESULTS:
Critical Crack Size has NOT been reached.
at Cycle No. 0.00 of Load Step No. 10
Step description:
of Block No. 10 of Schedule No. 70000
Crack Size c = 0.804184E-01

C-25 PSE F11 Forward Pressure Bulkhead

```
                   FATIGUE CRACK GROWTH ANALYSIS
                   -----------------------------
                 DATE: 09/15/98    TIME: 08:50:36
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
TC2, PSE-F11 FWD PRESSURE BULKHEAD CHANNEL 27-21063-2

GEOMETRY
--------
MODEL: TC02-Single edge through crack.

Plate Thickness, t =    0.0630
  "   Width, W     =    1.0000

FLAW SIZE:

c   (init.) =  0.5000E-01




MATERIAL
--------

MATL 1: 2024-T3
        Clad Plt & Sht; T-L; LA & HHA

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 :  65.0:  48.0:  41.0:  29.0: 1.00: 1.00:  0.063:  57.9:      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:    C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :          :     :    :    :      :      :     :SIGo :
:----:---------:-----:----:----:------:------:-----:-----:
:  1 :0.244E-07:2.601:0.50:1.00:  2.90:  0.70: 1.50: 0.30:
 TC2, PSE-F11 FWD PRESSURE BULKHEAD CHANNEL 27-21063-2
MODEL: TC02

FATIGUE SCHEDULE BLOCK INPUT TABLE
----------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    8.3000
Scale Factor for Stress S1:   0.00000
Scale Factor for Stress S2:   0.00000

Total No. of Blocks in Schedule =     1

   Block Number and Case Correspondences
 Block Number                  Block Case No.
From    -    To
    1   -     1                        1

SINGLE DISTINCT BLOCK
 S  : M:  NUMBER     :        S0         :        S1         :
```

```
T  : A:    OF         :                     :                     :
E  : T:  FATIGUE      :                     :                     :
P  : L:  CYCLES       :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:--------------:---------:---------:---------:---------:
  1: 1:          1.00 :   0.00:      1.00:     0.00:      1.00:
S  : M:  NUMBER       :        S2           :        S            :
T  : A:    OF         :                     :                     :
E  : T:  FATIGUE      :                     :                     :
P  : L:  CYCLES       :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:--------------:---------:---------:---------:---------:
  1: 1:          1.00 :   0.00:      1.00:     0.00:      0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-F11 FWD PRESSURE BULKHEAD CHANNEL 27-21063-2
MODEL: TC02

FATIGUE SCHEDULE BLOCK STRESS TABLE

```
STD
S  : M:  NUMBER       :        S0           :        S1           :
T  : A:    OF         :                     :                     :
E  : T:  FATIGUE      :       (ksi)         :       (ksi)         :
P  : L:  CYCLES       :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:--------------:---------:---------:---------:---------:
  1: 1:          1.00 :   0.00:      8.30:     0.00:      0.00:
S  : M:  NUMBER       :        S2           :        S            :
T  : A:    OF         :                     :                     :
E  : T:  FATIGUE      :       (ksi)         :       (ksi)         :
P  : L:  CYCLES       :   (t1) :  (t2)      :   (t1) :  (t2)      :
----:--:--------------:---------:---------:---------:---------:
  1: 1:          1.00 :   0.00:      0.00:     0.00:      0.00:
```

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET

TC2, PSE-F11 FWD PRESSURE BULKHEAD CHANNEL 27-21063-2
MODEL: TC02

ANALYSIS RESULTS:

Schedl	Block	Step	Final Flaw Size c	K max c-tip
4000	1		0.050459	3.792454
8000	1		0.050927	3.811160
12000	1		0.051405	3.830170
16000	1		0.051892	3.849492
20000	1		0.052388	3.869131
24000	1		0.052895	3.889095
28000	1		0.053412	3.909393
32000	1		0.053939	3.930031
36000	1		0.054477	3.951019
40000	1		0.055027	3.972365
44000	1		0.055587	3.994077
48000	1		0.056160	4.016164
52000	1		0.056744	4.038637
56000	1		0.057341	4.061505
60000	1		0.057951	4.084778
64000	1		0.058573	4.108468
68000	1		0.059210	4.132585
72000	1		0.059860	4.157141
76000	1		0.060524	4.182148
80000	1		0.061204	4.207618
84000	1		0.061898	4.233566
88000	1		0.062609	4.260003

C-25 PSE F11 Forward Pressure Bulkhead (Continued)

92000	1	0.063335	4.286946
96000	1	0.064078	4.314409
100000	1	0.064838	4.342407
104000	1	0.065617	4.370957
108000	1	0.066413	4.400077
112000	1	0.067229	4.429783
116000	1	0.068064	4.460096
120000	1	0.068919	4.491034
124000	1	0.069796	4.522620
128000	1	0.070694	4.554874
132000	1	0.071615	4.587819
136000	1	0.072559	4.621480
140000	1	0.073527	4.655883
144000	1	0.074521	4.691055
148000	1	0.075540	4.727023
152000	1	0.076587	4.763818
156000	1	0.077661	4.801473
160000	1	0.078765	4.840020
164000	1	0.079899	4.879495
168000	1	0.081065	4.919937
172000	1	0.082263	4.961386
176000	1	0.083496	5.003884
180000	1	0.084765	5.047478
184000	1	0.086071	5.092217
188000	1	0.087416	5.138152
192000	1	0.088801	5.185340
196000	1	0.090229	5.233841
200000	1	0.091702	5.283718

TC2, PSE-F11 FWD PRESSURE BULKHEAD CHANNEL 27-21063-2
MODEL: TC02

ANALYSIS RESULTS (contd)

Schedl	Block	Step	Final Flaw Size c	K max c-tip
204000	1		0.093221	5.335041
208000	1		0.094790	5.387884
212000	1		0.096410	5.442328
216000	1		0.098084	5.498459
220000	1		0.099814	5.556372
224000	1		0.101605	5.616168
228000	1		0.103459	5.677957
232000	1		0.105380	5.741862
236000	1		0.107371	5.808015
240000	1		0.109437	5.876559
244000	1		0.111583	5.947654
248000	1		0.113812	6.021474
252000	1		0.116132	6.098215
256000	1		0.118547	6.178089
260000	1		0.121064	6.261335
264000	1		0.123690	6.348219
268000	1		0.126434	6.439040
272000	1		0.129303	6.534133
276000	1		0.132309	6.633877
280000	1		0.135462	6.738702
284000	1		0.138775	6.849099
288000	1		0.142261	6.965632
292000	1		0.145937	7.088953
296000	1		0.149821	7.219819
300000	1		0.153934	7.359114
304000	1		0.158301	7.507886
308000	1		0.162950	7.667380
312000	1		0.167915	7.839095
316000	1		0.173236	8.024852
320000	1		0.178962	8.226895
324000	1		0.185151	8.448025
328000	1		0.191876	8.691800

C-25 PSE F11 Forward Pressure Bulkhead (Continued)

332000	1	0.199230	8.962820
336000	1	0.207330	9.267169
340000	1	0.216331	9.613109
344000	1	0.226443	10.012218
348000	1	0.237957	10.481384
352000	1	0.251305	11.046504
356000	1	0.267152	11.750003
360000	1	0.286623	12.668068
364000	1	0.311858	13.957467
368000	1	0.347833	16.023622
372000	1	0.412448	20.596933

```
ADVISORY: Net-section stress > Yield and failure is imminent
(Unless (a) UTS > 2 YS, or
(b) KIc/YS > 0.5 sqrt. in.(2.5 sqrt. mm.) and bending dominates.)
at the very beginning of Load Step No.    1
Step description:
of Block No.      1  of Schedule No.  373756
Crack Size     c =  0.476985

FINAL RESULTS:
Net-section stress exceeds the Flow stress.
(Flow stress = average of yield and ultimate)
at the very beginning of Load Step No.    1
Step description:
of Block No.      1  of Schedule No.  374211
Crack Size     c =  0.511567
```

C-26 PSE F13 Control Column Roller Bearing

```
                    FATIGUE CRACK GROWTH ANALYSIS
                    -------Modified by FAI-------
                  DATE: 18-DEC-98    TIME: 09:26:57
        (computed: NASA/FLAGRO Version 2.03, March 1995.)
        U.S. customary units [inches, ksi, ksi sqrt(in)]

PROBLEM TITLE
-------------
SC7, PSE-F13 CONTROL COLUMN ROLLER BRNG (NEW DESIGN)

GEOMETRY
--------
MODEL: SC07-Part-circular Surf. crk on cylinder circ. plane

Cylinder Diameter, D =    0.5000

FLAW SIZE:

a   (init.) =  0.5000E-01



MATERIAL
--------

MATL 1: xx-xPH Alloys  17-4PH
        H1025; Rnd Bar, C-L

Material Properties:

:Matl:  UTS :  YS  :  K1e :  K1c :  Ak :  Bk :  Thk  :  Kc  : KIscc:
: No.:      :      :      :      :     :     :       :      :      :
:----:------:------:------:------:-----:-----:-------:------:------:
:  1 : 163.0: 160.0:  70.0:  55.0:     :     :       :      :      :

:Matl:---------- Crack Growth Eqn Constants -------------:
: No.:     C     :  n  :  p :  q :  DKo :  Rcl :Alpha:Smax/:
:    :           :     :    :    :      :      :     :SIGo :
:----:-----------:-----:----:----:------:------:-----:-----:
:  1 :0.150D-09:3.500:0.25:0.25:  4.00:  0.70: 2.50: 0.30:

MODEL: SC07

FATIGUE SCHEDULE BLOCK INPUT TABLE
---------------------------------
STD

[Note: Stress = Input Value * Stress Factor]

Stress Scaling Factors for Block Case:  1

Scale Factor for Stress S0:    0.0000
Scale Factor for Stress S1:    4.0000

Total No. of Blocks in Schedule =      1

   Block Number and Case Correspondences
 Block Number                    Block Case No.
From   -   To
   1   -    1                        1

SINGLE DISTINCT BLOCK
 S  : M:  NUMBER     :        S0          :         S1         :
 T  : A:    OF       :                    :                    :
 E  : T:  FATIGUE    :                    :                    :
```

C-26 PSE F13 Control Column Roller Bearing (Continued)

```
 P  : L:  CYCLES      :    (t1) :  (t2)    :    (t1) :  (t2)    :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.00 :    1.00:    -1.00:     1.00:    -1.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 SC7, PSE-F13 CONTROL COLUMN
MODEL: SC07

FATIGUE SCHEDULE BLOCK STRESS TABLE
-----------------------------------
STD
 S  : M:  NUMBER      :        S0         :        S1         :
 T  : A:    OF        :                   :                   :
 E  : T:  FATIGUE     :      (ksi)        :      (ksi)        :
 P  : L:  CYCLES      :    (t1) :  (t2)   :    (t1) :  (t2)   :
----:--:-------------:---------:---------:---------:---------:
   1: 1:        1.00 :    0.00:     0.00:     4.00:    -4.00:

Environmental Crack Growth Check for Sustained Stresses
(Kmax less than KIscc): NOT SET
                        -------
 SC7, PSE-F13 CONTROL COLUMN
MODEL: SC07

ANALYSIS RESULTS:
-----------------

FINAL RESULTS:
All Stress Intensities are below the Fatigue Threshold.
NO growth in Schedule No.        1
Crack Size      a =  0.500000E-01
Corresponding semi crack length, c = 0.553286E-01
```